Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting
PUBLISHED BY McGRAW PUBLISHING COMPANY, INC.

Volume 71 NEW YORK, SATURDAY, MARCH 13, 1915 Number 11

Hydroelectric Bills Fail

THE adjournment of Congress last week witnessed the death in the Senate of the hydroelectric bills upon which so much time had been expended. Neither the measure for regulating powers on navigable streams nor that relating to powers on the public lands could receive the consideration of the Senate—the penalty for the administration's insistence upon the ship-purchase bill. Both measures were slated as part of the administration's conservation program and probably would have gone through had it been possible to give them consideration. It is a matter of deep regret that the bills failed of enactment, for it means at least another year of delay in developing the country's unused water power. True, many will believe that the delay at this particular time is not very serious, due to the adverse financial conditions. But, on the other hand, the cheapness of money would probably attract capital to such investments, if under the reasonable restrictions of the redrafted Adamson and Ferris Bills. One hydroelectric engineer of note has assured this journal that if the bills had gone through one project, in particular, requiring an investment of $10,000,000, would have been undertaken immediately. The work done, of course, in whipping the bills into proper shape is not lost, for the measures can be introduced in the next session. A year's delay, however, is now unavoidable.

Wharton Tract Purchase

THE New Jersey Water Supply Commission must abandon, for the present at least, the proposed acquisition of the 110,000-acre Wharton tract, for supplying water to a number of towns in the southern part of the State. On March 1 the Court of Errors and Appeals reversed the decision of the Court of Chancery validating the purchase of the tract through a $1,000,000 bond issue. The point at issue was whether the State Water Supply Commission had power to issue such bonds when the New Jersey constitution prohibits the creation of any State indebtedness exceeding $100,000, except by direct vote of the people. The lower court held that the proposed bond issue was allowable on the ground that the commission is a corporation distinct from the State. The opposite point of view is expressed by Justice Garrison in the majority opinion of the Court of Appeals. His reasoning, based upon the fundamental maxim of agency, is that the Legislature creates whatever it authorizes its agents to create. Hence, in authorizing the Water Supply Commission to incur an indebtedness, the Legislature has, in effect, incurred such an indebtedness itself. This, according to the higher court, is clearly in violation of the constitutional provision previously referred to. The purchase of the tract will now depend upon the ratification of a bond issue by the voters.

Destructive Testimony

IN these days when the railroads are especially in need of fair treatment at the hands of the public and are using press and platform to present their side of the case, it is doubly unfortunate that a few roads still tolerate certain indefensible practices on the part of employees who display more zeal in gaining a particular point than wit in perceiving the overshadowing sacrifice in public esteem. The attention of this journal has been called to the testimony of a railroad engineer in connection with an evaluation for taxation purposes. This individual blandly explained under oath how, by the use of certain methods and equipment, earth could be excavated for railroad purposes for 4.9 cents per cubic yard, solid rock be taken out for 15 cents, and reinforced-concrete arches built for $2.415 per cubic yard. Although the railroad in question handles a high-speed passenger service, it is probable that the witness would not venture on it himself, because he estimated these same concrete arches to be depreciated 44 per cent, while signals in service 7 years were thought to have fallen off 70 per cent in value. Verily the road should be condemned as unsafe! Granted that the powers that be too often fail to differentiate values for taxation and for rate-making purposes, that the deduction of depreciation is proper in the one and not in the other, and that both values are to a large extent matters of opinion, it seems worse than useless to indulge in such absurdities as the figures above. The railroads should perceive the folly of such confidence-destroying tactics. Incidentally the case in question was decided against the railroad.

Important Valuation Conference

ANNOUNCEMENT is made elsewhere in this issue of a valuation conference to be held in Washington, beginning March 22, by the Division of Valuation of the Interstate Commerce Commission. Judging from the questions raised, which are only "among those to be considered," it seems that practically every mooted point in connection with the appraisal of the railroads will be discussed. Apart from the radical differences of opinion that exist as to the principles of valuation, one problem of detail after another has been uncovered since the Government's evaluation work was started, and now that the commission has virtually finished with a number of roads, it has wisely decided to give the carriers a chance to present their views on these points of detail. When the inventories are completed there will still be questions as to the form of presenting the data to Congress, as to the information to be given the various States and the method of keeping the records up to date. Therefore, the State commissions are invited to take part in the discussions. The announcement of the conference again brings home the fact that there are a vast number of complications in this work, from fundamental principles down to the smallest details. It is evident that the meeting will be replete with interest for the valuation engineer.

Dry Rot Needs Study

SOMEWHAT over a year ago F. J. Hoxie, engineer and special inspector of the Associated Factory Mutual Fire Insurance Companies, presented a paper before the American Society of Mechanical Engineers on the difficulty of securing proper timber for use in the construction of mill buildings. He also pointed out the extent of the ravages from dry rot. Appreciating how important these questions were, the Engineering Record opened its columns to a discussion of the subject and thereafter followed very closely the efforts of certain of the timber producers to devise a grading specification that would remove the objections made by Mr. Hoxie. The agitation started by Mr. Hoxie resulted in the adoption of a rather stringent specification by a committee of the Yellow Pine Manufacturers' Association and, later, of a somewhat less stringent specification by the Georgia-Florida Sawmill Association. Mr. Hoxie has continued his investigation and has now brought out a second edition of the pamphlet on "Dry Rot in Factory Timbers," first issued somewhat over a year ago. An abstract of its conclusions will be found on page 336. A reading of this document strengthens the conviction of this journal, already formed, that a very careful investigation into the fungi which attack wood is needed. The Germans have done considerable work along this line, but more information is wanted. The data cannot be secured from loosely-planned or fragmentary experiments, but only through an elaborate series of tests, carried on with first-class facilities and by experienced men. The Forest Products Laboratory, at Madison, has made an excellent start and it is hoped that funds may become available for a broadening of the work. This becomes all the more necessary as the difficulty of securing timbers of the highest grade increases. The investigations should include not only studies of fungi and their propagation but also of treatment methods economical and satisfactory for mill timbers. The subject is important enough for thorough study.

Effectiveness of Snow-Fighting Demonstrated in New York

UNTIL last week it seemed probable that an early spring would rob John T. Fetherston, commissioner of the New York Street Cleaning Department, of an opportunity for a fair test of the elaborate "snow-fighting" plan which he had been perfecting, on paper, for more than a year. The handling of last Saturday's storm, however, demonstrated that organized snow-fighting, which involves putting emergency men by the thousand to work while the storm is still in progress and using the sewers for carrying away the snow, is not an impractical scheme, but a workable plan, which can be depended upon to open up New York's streets in a surprisingly short time. On Sunday morning most of the principal thoroughfares were cleared sufficiently to permit normal traffic to be maintained. Progress on the side streets was well advanced by nightfall.

From observations at several of the uptown sewer manholes, to which snow was being carted, thereby saving a long haul to the riverfront, a few facts were evident. The bottom-dump wagon used by some of the snow-removal contractors is not nearly so well suited for this work as the back-dump cart, employed by the Street Cleaning Department for the collection of ashes. Last week's snow was not light, but wet and slushy, and when the bottom leaves of the wagons were opened the load frequently failed to fall, but arched against the sides of the wagon. After forcing it down, it still protruded into the body, making it difficult to start the team. Moreover, with the back-dump carts, the load was always backed up to the manhole and deposited over the opening. The bottom-dumps seldom discharged over the manhole but to one side, thereby entailing extra shoveling. It should be remembered, however, that snow removal in New York is emergency work and all sorts of vehicles are impressed into service, irrespective of their particular fitness.

At certain places there was delay due apparently to a conflict of authority between the various representatives of the city—the Street Cleaning Department, the Finance Department and the Bureau of Sewers. In one case half-a-dozen carts were waiting to dump, with a clear manhole opening available. Nearby on the street were three or four loads of snow which had been deposited by bottom-dump wagons. Instead of allowing the full carts to discharge immediately and start back for new loads, the inspector insisted on the clearing of the several mounds of snow already on the ground. This work could well have been postponed, and time saved for the carts and drivers.

The importance of these points, however, should not be exaggerated. On the whole the work proceeded smoothly and efficiently. It is gratifying, too, that the Bureau of Sewers had no complaint to make; no serious stoppage nor damage to the underground structures has been reported. This has an added interest, for when the snow-removal plan was first proposed the sewer engineers objected, fearing interruption to the normal service of the conduits.

The result indicates what can be accomplished by co-operation among municipal departments, for while the Street Cleaning Department bore the brunt of the work, it was ably supported by the sewer and police divisions, the members of the police force having been assigned the duty of calling out the emergency snow-fighting force and checking up the loads at the manhole dumps.

Efficiency, 20 Per Cent

IN this issue the Engineering Record brings to a close the series of six articles by Nathan C. Johnson on the use of the microscope in the study of concrete. The closing article takes up the low percentage of hydration of cement and details the studies made to discover a method for increasing the percentage. Some question has been raised by readers of previous articles as to the accuracy of the statement that only 20 per cent of the cement is hydrated and is thus efficient as a cementing material. Probably the demonstrations of the article in this issue will prove convincing, but those who still doubt may be referred to studies of the Bureau of Standards which show, according to P. H. Bates, that the percentage of cement hydrated does not run as high as Mr. Johnson has put it. Theoretically, then, the efficiency of cement in a concrete mixture is only 20 per cent. Some of it, it is true, acts as a very finely divided void-filling material, and thus serves the same purpose as a finely ground inert substance. Manifestly, however, the increase in the percentage of hydration, combined with the elimination of the water and air voids, which formed the subject of earlier papers in the series, will result in raising very appreciably the strength of concrete mixtures. Experiments made on the theory that the percentage of hydration can be increased by lowering the surface tension of the mixing water are not yet conclusive, but they are sufficiently encouraging to warrant further careful study along this line. The surface tension theory was taken up as the basis for the present test only after various machines, designed to secure a more intimate union of the water and cement, had failed to produce the desired result.

In undertaking the series it was the belief of this journal that the microscope had in a most striking way verified some of the opinions generally held as to the causes of poor concretes. The demonstrations, moreover, of the bearing on strength of proportion of matrix to aggregate, of the effect of the burden which air and water voids put upon the aggregate, of the progress of disintegrating dikes in concrete exposed both to sea and to fresh water, of the determination in a set concrete of the proportions used, and, finally, of the possibilities opened by increasing the percentage of hydration of cement are all valuable contributions to our knowledge of this most important building material. Valuable, as these demonstrations are, the Engineering Record hopes with Mr. Johnson that the series will result in a wider application of the microscope and a study of its possibilities by many different investigators. Only in this way will the true value of the method be quickly determined and the full benefit of whatever possibilities it holds obtained. If the demand for the articles and the widespread favorable comment are an indication, then the wider studies will surely be undertaken.

River Freight Terminals Receiving More Consideration

WEEK before last there met for the first time, in St. Louis, a River Terminals Conference, which resolved, before its adjournment, to become a permanent organization, placing the initial work in the hands of an executive committee headed by former Governor Eberhart, of Minnesota. The conference will confine its efforts to river terminal work and will not encroach upon the activities of other organizations interested one way or another in water transportation.

The organization of this conference and its resolution to become a permanent body are hopeful signs. Heretofore agitation regarding water transportation looked only to the deepening of channels, ignoring entirely that such channels as we now have are not used to anywhere near their possible capacity, and that, lacking adequate terminals, even the deepest channel is of no value. Those who have thoughtfully considered transportation problems have long realized the fundamental deficiency in this respect of American rivers, but unfortunately the propaganda has in the past been in the hands of professsional publicity agents and politicians, who were more interested in getting appropriations from the National Government, for political reasons—as a sop to constituents—than in building up the country's water transportation. It was inevitable that the real difficulty should eventually be appreciated, and if appreciation has come only after tremendous energies have been exhausted in wrong directions we may be thankful, at least, that the "spread-eagle" orators and the "interests-of-my-district" men have not been able longer to defer popular realization of the difficulty.

It must not be thought that this conference is the first realization upon our imperial water system of the Middle West of the need for river freight terminals, but it is a sufficiently large step to call for special comment. For two years or more the Upper Mississippi Improvement Association, which has been largely responsible for the betterments made in the navigability of the river above Cairo, has preached the gospel of terminal needs, while local associations, such as the Greater Davenport Committee, have taken up the propaganda vigorously. Education in these matters, however, is slow and about all that has been achieved so far is to convince a great many of the thinking people along the Mississippi that the rehabilitation of the river trade is not to come through nourishment from the public "pork barrel," but by municipal initiative in building adequate terminals and private initiative in financing boat lines designed for present-day needs and present river depths. The river cities are now displaying much activity and Davenport has a large terminal scheme under way. Other cities are promising early results.

Of private enterprises for providing the necessary transportation units, there are a number in course of development. The latest announced is that of John H. Bernhard, of New Orleans, who has already demonstrated by his work on the lower river his ability to organize and conduct freight lines adequate for the Mississippi River service. He proposes to run self-propelled barges, each of 3000 tons capacity, having four propellers and 7-ft draft, between New Orleans and St. Louis. The barges are to have an upstream speed of 15 miles an hour. On the upper river 1000-ton barges, with two propellers and one center stem wheel, and an upstream speed of 10 miles per hour, are to be used. At present negotiations are under way between Mr. Bernhard and the city of St. Paul for the necessary land for a terminal.

There is ground for believing, therefore, that the solution of the water transportation on the Upper Mississippi is closer at hand than for many years. Action has taken the place of agitation and a determination to help themselves has replaced to some extent the clamor for Government funds. The new River Terminal Conference should help greatly in spreading sound doctrine on water transportation, and as its influence grows we may look forward to at least some partial realization of the possibilities of the Mississippi and Missouri River systems. Much has already been accomplished on the Ohio, but there, too, there is room for much greater development.

Chaos in Apportioning the Cost of Grade-Crossing Elimination

GRADE-CROSSING elimination assumes each year a more important place in the railway budget. Without a doubt expenditures under this head will increase very rapidly, and we may expect that within a comparatively few years we shall come, in the East at least, to a railroad network free from grade crossings in all cities and villages. Even crossings in the country will be very largely eliminated.

The question, then, is a most important one, not only for the railroads but also for the States, counties and municipalities. The engineers representing these parties must be looked to to think correctly on the matter and exercise their influence to secure proper legislation.

No argument, we believe, is needed in favor of a very careful study of the problem. And the need for such study becomes all the more apparent when a preliminary investigation shows that twenty States have no laws whatever touching upon grade separation, that in nearly as many more the public service commission is empowered to fix the division of expense for elimination between the public authority and the railroad, and that in only ten States has an effort been made to fix definitely the expense proportions. Moreover, in no two of these ten are the proportions the same.

The problem is not by any means a simple one, for it involves not only the proper distribution of the expense of eliminating existing crossings, but also the correct methods of distribution on new work, the assessment of a proportion of the cost upon electric railways using the highway, the protection of existing crossings, and the development of some scheme of State appropriation which will insure proper progress. All of these factors are discussed in the article on page 327.

It would seem that participation by the public authority in the cost of elimination work had been frequent enough to take the question as to its advisability out of the domain of discussion. It is true that the principle has not been universally accepted and that it may not be an easy matter to convince State Legislatures that such participation is but justice to the railroad which was built under conditions radically different from those now obtaining. To saddle upon them the cost of a work from which the public receives a benefit greater even than that of the railroad, appears to savor of taking property without due process of law, and to be based on the erroneous notion that the railroad is a trespasser at every crossing at grade. While, therefore, the point may need argument before legislative bodies, in discussing before engineers the proper method of paying the elimination bills, such participation may be assumed to be an accepted and approved principle.

Theoretically it might be argued that the apportioning of the cost should be dependent in each case upon the benefit which the railroad and the various public authorities derive from the work. Apparently this has been the plan followed by some of the public service commissions in making allotments. Theory on this phase of the subject, however, must apparently be very fine spun, though there may be cases where the benefit to one of the parties is of so peculiar a character as to leave little or no room for dispute. In the ordinary case, however, increased safety to pedestrians and vehicular traffic are to be weighed against flagging and damage suit costs; evidently a problem with a large intangible element. Normally, one would evaluate the increased safety far above the financial saving to the railroad. Nevertheless, it would, in the present temper of our people, be practically impossible to get the public authority to pay a larger share than does the railroad, and the best that can be hoped for, then, is an even division of cost. It is important, however, that the even division be based upon the total cost of the work. Arrangements by which certain parts of the work are paid for by each party, generally resulted in a disproportionate allotment.

As to the division between the State, the county and the municipality of the expense to be borne by the public authority, that again opens up a great many questions that need discussion. It forms of itself so large a problem that Mr. Stark has not attempted to cover it in the article above referred to. It would appear, however, that this division among the public authorities was no concern of the railroads and that the railroad engineers would be finished with the problem when agreement was reached as to the proportion which the railroad should bear.

For the municipal authority, however, there enters still another problem—the share of expense falling to an electric railway occupying the highway. There are two possible points of view. They are stated here merely in the hope that discussion will result which will enable a decision to be reached.

If the existence of an electric railway in the street or road causes a definite increase in the cost of elimination—either for providing greater clearance in under-crossings or heavier steelwork in over-crossings—it would seem proper that this whole extra cost should be assumed by the electric railway. Then, over and above that, there is question as to the further proportion of the public authority's share which the railway should assume. Moreover, there is then the proportioning of the extra expense involved where provision is made for future electric railways.

The other method of approach would be to assume that the electric railway is part of the highway, and that whatever proportion of the expense it shares should be deducted from the percentage allotted the public authorities.

Space does not permit here a discussion of some of the other phases which a thorough study of the grade-crossing elimination law naturally brings up, but the article already referred to points out how the decisions reached on existing crossings may bear on the protection of those crossings which are not eliminated, on the building of new crossings for the railroad, and on new street and highway openings across railroad right of way.

It is apparent, however, from what has been said that thorough study of the problem is needed and full discussion of existing laws. No better plan, it seems to this journal, is possible than by the appointment by the American Railway Engineering Association, which meets in Chicago next week, of a special committee instructed to study the question. Surely it looms large enough in railway finances to warrant the expenditure of time even by the already very busy men who compose the association. Many of them are deeply concerned with the problem now, and those who have not yet had to worry about it are destined to learn before long how difficult it is. The association has done great work for the railways of the country. Its activities are many. Its members give most generously of their time. An additional activity should not be urged without good reason, but the problem is so important that the Engineering Record has no hesitancy in bringing the matter to the attention of the members.

High-Strength Concretes Produced Through Lowering of Surface Tension of Mixing Water

Final Article in Series of Six—Showing How Microscope Has Led to Discovery of Reason for Low Percentage of Hydration of Cement, and Describing Experiments for Increasing the Percentage

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TO be of the highest value, research in any line must find, directly or indirectly, an economic application. The improvement of concrete in quality, cheapness and strength is an economic goal of no mean order; and the measure by which all concrete investigation must be judged will be the degree of improvement that will ultimately be brought about in the commercial product. Any change from established ideas and procedure, no matter how desirable, is necessarily slow of acceptance, but once the feasibility of accomplishing desirable ends is proved, time alone should be the only factor influencing the general adoption of the new methods.

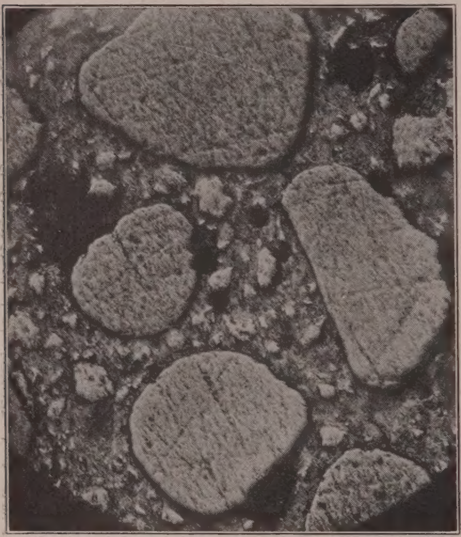


FIG. 29—UNHYDRATED CEMENT IN 1:3 STANDARD SAND BRIQUETTE, 90 DAYS OLD; 50 DIAMETERS

Previous papers of this series may have appeared iconoclastic. Concrete has been dealt with not as a universal, ideal material, but as one excellent in spite of its deficiencies and susceptible of the very greatest improvement, once these deficiencies are recognized. Believing that continued laboring under removable limitations is an inefficient policy, and finding further that many of these deficiencies of concrete are due to very definite causes, certain weaknesses and faults have been pointed out at some length to emphasize human fallibility and carelessness as the responsible factors, rather than the materials themselves. Especially is this true as regards processes such as are involved in mixing a finely-divided substance with water. Apparently one of the simplest of operations, this is yet one of the most difficult to accomplish, as was demonstrated in Article 5 of this series. In the course of the present paper, its extreme importance to the strength of concrete, by reason of inefficient and insufficient wetting of the cement, will be particularly emphasized.

It will be remembered that certain lumpy formations found in commercial concretes have been previously designated as groups of particles of unhydrated cement. It has also been stated, with the prevalence of these groups as a partial basis, that not more than 20 per cent of the total cement added to concrete is effectively used. Obviously, these statements require most rigid proof, but if they are proved, the future of concrete construction is bright with promise for wider usefulness by a simple development of the material already at hand. For instance, the present effective percentage of cement allows us to use our accustomed stresses, say, 600 lb. per square inch in compression, with the strength in tension considered as zero. If the compressive strength alone could be *doubled*, regardless of the possible tensile strength developed, columns and beams could be stressed to *twice the present allowable limit;* and corollary to this, though perhaps not in the same ratio, the size of members and the quantity and, therefore, the cost of materials required for them could be decreased. Or to be more sanguine, if it were possible to impose *three times*, or *four times* the present allowable stress, the future possibilities of concrete as a structural material would almost stagger the imagination.

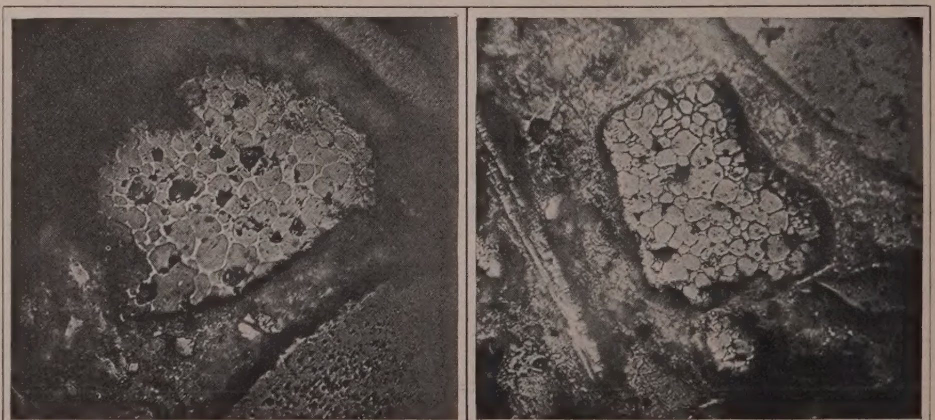
All these visions must fade, however, unless this low efficiency of use can not only be proved, but means for improvement demonstrated. This requires, as a first step, a determination of the percentage of total cement represented by these lumpy formations, and their identification as unhydrated cement.

IDENTIFICATION OF UNHYDRATED CEMENT

To gain some information in this regard, it may be well to section and polish a mortar briquette made from known materials—for instance, standard Ottawa sand and an approved grade of cement. A photograph of a section of such a briquette, stored under water for 90 days after mixing, shows as in Fig. 29. In this photograph identification of materials is made easy, as only standard sand and cement and water entered into the briquette; and as the standard sand grains are unmistakable because of their form and their size, the material can be nothing other than cement, either hydrated or unhydrated. By direct vision through the microscope, the lumps between the sand grains can be further identified by their characteristic brown, or brownish-green, or greenish-black color, as unhydrated cement; and by elimination, the white mass in which they lie embedded can be nothing else than partially or wholly unhydrated portions of the same material.

If a planimeter were used to integrate the areas of this section, as in the method of analysis before described (Engineering Record, Feb. 27, 1915, page 263), the basis for the quantitative estimate of 80 per cent of cement remaining unhydrated could be understood. The appearance of sections such as this led to the undertaking of this research on the improvement of hydration some four years ago; and since that time, the investigation has been pushed unremittingly, a portion of the results so obtained being presented in these pages.

As seen in this photograph, however, the lumps of cement do not appear similar to those honeycomb formations found in concretes which have been previously designated as groups of unhydrated cement particles. This is because in Fig. 29 the magnification is low and also because the structure of the cement lumps has not been developed in polishing, but if the latter is done and examination made at a higher power, the structure of (a) in Fig. 30 is revealed; while contrasted with this is the structure (b) of the same figure, found in a commercial concrete, taken from a dock wall in New York harbor. And as before, visual examination further confirms the



(a) Ottawa Sand Mortar (b) Dock Wall Concrete

FIG. 30—GROUPS OF UNHYDRATED CEMENT PARTICLES; 300 DIAMETERS

identity of these materials whose structures are compared, by showing the characteristic greens and browns and blacks of unhydrated cement, which are lost in the photographs.

FORMATION OF UNHYDRATED GROUPS

Assuming, then, the identity of these formations as grouped particles of unhydrated cement to be established, it becomes of prime importance to inquire as to how and why such groups occur, and as to how their unhydrated condition is maintained unchanged, regardless of conditions of moisture, in order that means may be found to prevent their future formation and to insure their component particles entering actively into the concrete. Evidently, these particles were more or less wetted at one time, for the net-work boundaries are found by examination to be composed of a mixture of wholly or partially hydrated cement, but why the hydrating action stops short after the initial moistening is less evident, but most important to determine. Obviously cement and water are the two reacting substances; and to secure thorough reaction there must be thorough contact between them. Any grouping, therefore, that would prevent a proper access of water to the cement, would result in an incomplete reaction, with consequent detriment to the quality of the concrete.

To understand the causes of formation of these groups in concrete it is necessary to consider briefly the general chemical nature of cement.

All Portland cements contain, in varying amounts and combined in devious ways, a number of chemical "radicals"—CaO, MgO, SiO_2, Al_2O_3, Fe_2O_3, SO_3, and so on. The presence of some of these compounds is due to the composition of the raw materials, while that of others, notably a certain portion of the CaO and SO_3, is attributable to the secondary addition of gypsum to the finished product.

SETTING AND HARDENING

It follows from the complex nature of cement, that the reactions occasioned by its admixture with water are themselves complex. Indeed it is doubtful if these reactions are even now fully understood. Many are yet matters of controversy, but regardless of their exact chemical nature, it is well established that in the passage from the semi-fluid state of gaged cement to that of the hardened product, there are two distinct stages, the first known as *setting*, being that in which the mass loses its plasticity and becomes more or less friable; and the second, known as *hardening*, in which consolidation takes place, the mass gradually increasing in hardness with the passage of time, until a stony texture is obtained. It is probable that the reactions of setting involve the formation of supersaturated solutions, with deposition therefrom of close-knitted, interlacing crystals; while the slower process of hardening involves partly the formation of similar interlacing crystalline products, but more especially the production of a colloidal (amorphous), "gel," or glue, of calcium hydrosilicate, followed by gradual desiccation, or drying out. In the light of this knowledge, the grouping of cement particles and their maintenance in an unhydrated state, regardless of passage of time or surrounding conditions of moisture, will be better understood.

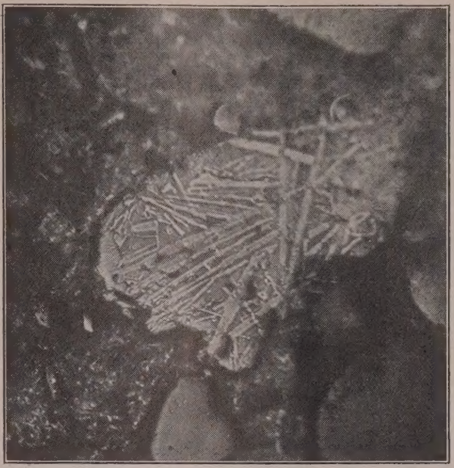


FIG. 31—PIECE OF CLINKER IN OLD CONCRETE

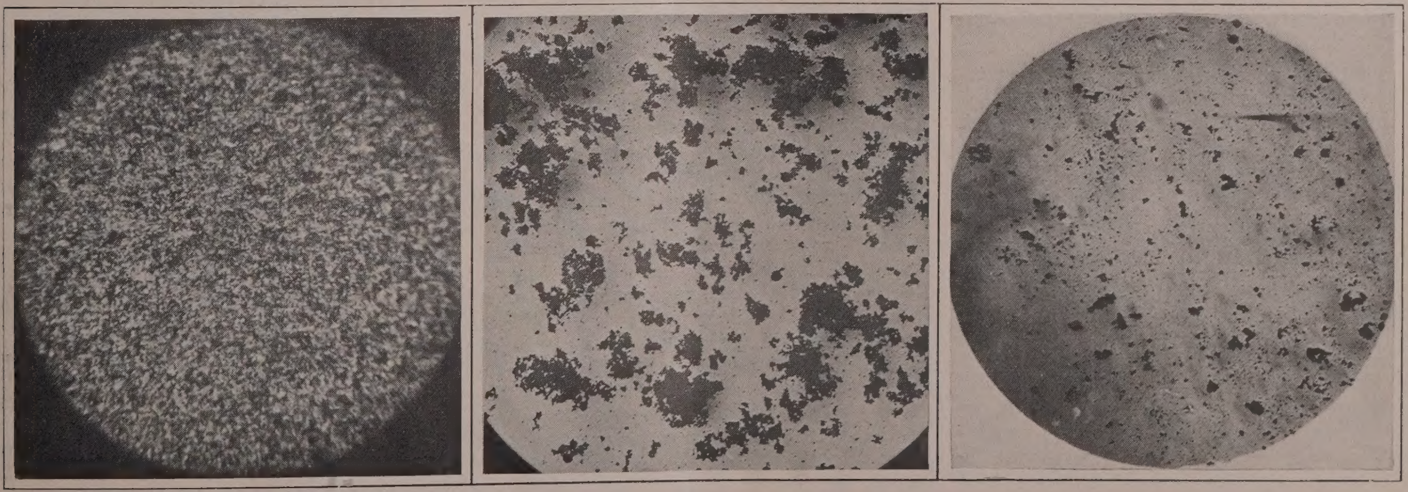
The crystals were formed by breathing on the polished surface.

In Article 5 of this series the effect of surface tension, as exhibited by the close compacting of materials brought into contact with water, was demonstrated, such compacting being effective in direct proportion to the size and mass of the particles. With a material so fine as cement this compacting must be extreme. But close compacting of these particles would necessarily mean the exclusion of all but a very small percentage of water from between the particles; and this being so, it is beyond question that a highly supersaturated solution of the more soluble portions of the cement would speedily result, with consequent deposition in crystalline form of those highly-soluble aluminates, to which initial set is due. It should be understood further that under such conditions, this process is completed in a far shorter time than is required to produce initial set where free access of water is permitted, so that in a period that is very probably measured in seconds the cement particles forming these groups are bound together closely by interlacing crystals, possibly of the same type as those in the photograph of Fig. 31, which shows the crystals formed by breathing on the surface of an unusually large piece of cement clinker, found in an old concrete taken from a dock wall in New York Harbor. But whether of this variety or not, since these groupings remain intact, this crystalline bond is evidently of a strength sufficient to withstand the mechanical agitations of mixing, especially when the mixing time is cut short in order to have the mixer deliver "a batch a minute." And as time goes on, the bond increases further in strength by the gradual formation of colloidal products, which desiccate through the absorption of water by the interior of the particles, producing those enduring honey-comb structures found in the cement matrix of all concretes, regardless of age.

INSUFFICIENCY OF WATER

It should be recognized, also, that this colloid boundary, which entirely surrounds each particle, operates further in the prevention of progressive hydration by reason of its constituting an impervious envelope or skin, through which water cannot pass. As before stated, close grouping admits of the presence of only a small quantity of water between the particles, far too little to satisfy the chemical requirements of the cement; and since further water attack is prevented by this envelope, it should not be a matter of surprise that concretes submerged for 30 years or more show about the same percentage of unhydrated cement as those quite recently made. Time and extraneous moisture are not the only factors necessary for effective hydration.

This outline of the formative processes of these groups of unhydrated particles is not merely an hypothesis. It is quite susceptible of visual demonstration, and, further, through such demonstration, remedial



(a) Dry Cement, Passing 100-Mesh Sieve (b) Cement with Water Added (c) After Addition of Alcohol to Water

FIG. 32—ADDITION OF A DEFLOCCULATOR TO MIXING WATER CAUSES DISPERSION OF CEMENT GROUPS; 60 DIAMETERS

measures of the greatest significance are indicated.

In Fig. 32 at (a) is shown Portland cement of a fineness passing a 100-mesh sieve, dusted on a microscope slide. The magnification is low, but it is high enough to enable the individual particles to be distinguished. At (b) is shown the same field, after the addition of water to the cement. No longer are the particles individual, but grouped in close masses of varying sizes, whose general outlines are not unlike the outlines of the groups found in the standard sand mortar and in concretes. Obviously, if time were allowed sufficient for the primary crystalline and the later colloidal products to form between the previously individual particles which are known to compose these masses, their continuance in their present grouped and unhydrated state would be the natural expectation.

Lowering Surface Tension

If hydration is to be promoted, and if these groups may be held in a large part responsible for the low percentage of hydration, it is obviously necessary either to break them up, or to prevent their formation. Further, since *surface tension* seems to be initially responsible for their existence, the most obvious remedy would seem to be to lower the surface tension of the mixing water by one means or another.

In (c) of the same figure is seen the effect of doing this by an addition of alcohol to the water of the field seen in (b). The effect is immediate and instantaneous. *No longer is the cement massed in large groups, but is widely and generally dispersed.* In thus lowering the surface tension, those forces which before limited the boundaries of the water were so lowered as to extend the fluid, so that in this last photograph, only a portion of the material shown in the others remains in the field, but the effect on the groupings is none the less evident. Beyond any question, the particles in (c) are more individualized and in a far better situation to react with the mixing water than were those in (b); and if such a result were obtainable in commercial mixing, with a proportionate quantitative increase in hydration of the cement, there should result a most important and desirable improvement in both the strength and quality of concrete. But before taking up a consideration of the results obtained from experiments along these lines, it is well to consider the wider import of such an improvement.

Theoretical Loss Due to Low Percentage of Hydration

There is no exaggeration in the statement that not more than 20 per cent of the total cement added to concrete is hydrated, or usefully employed in any way save as a space-filler—a function better and more cheaply performed by a high-strength material, such as sand. On the contrary, there is already ample proof of this low efficiency of use derived not only from the researches of the writer, but from those of the Bureau of Standards at Pittsburgh as well, to which reference is made by permission. It further seems, as investigation is extended, as if this figure of 20 per cent is conservative and that the actual percentage of hydration is below that figure by a considerable margin. But for the present, the percentage hydrated will be considered as 20 per cent of the total cement.

It should be understood, however, that the inference is not to be taken that with complete hydration, only one-fifth of the present quantity of cement would be required. Such an inference is not warranted by what is yet known of this material, but it is beyond question that with efficient hydration, a very substantial reduction in quantity for any given strength could be made.

On this basis of 20 per cent, however, consider the economic loss involved. During the year 1913, the cement production of the United States, in round figures, was 92,000,000 barrels. Assuming an average price of $1 per barrel, the total cost to the consumer for the twelve months was $92,000,000; and on the basis of 20 per cent being usefully employed in concrete, the active value of the product was $18,400,000, or a loss of $73,600,000. To offset this would have been the value of the sand required to replace as a space-filler the 80 per cent of unhydrated cement—in round figures, $2,361,000, leaving as a direct net economic loss the stupendous sum of $71,239,000, chargeable apparently as wastage to the concrete industry. It behooves engineers to ponder these figures and to be alert to any means that promise their reduction.

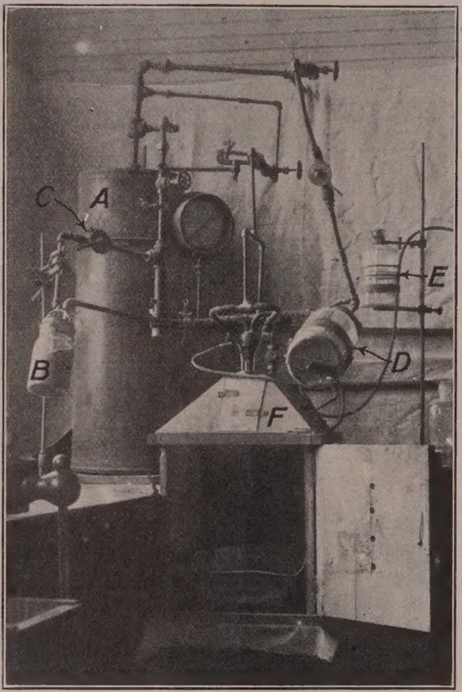


FIG. 33—HYDRATING APPARATUS (DISCARDED)

But this direct loss of $71,239,000 is not the full tale. It is profitable to consider the value of those structures in which this cement was incorporated. It is an acknowledged, indisputable fact that failures of concrete structures have occurred in the past for one reason and another; and it is reasonable to assume that other failures will occur in the future. In a previous article of this series (Engineering Record, Feb. 6, 1915), some of the causes of such failure have been demonstrated; and it has been shown that certain of these causes of failure have their inception in those imperfections resulting from directly assignable causes in mixing and placing. How much of the 1913 cement is in concrete of this character? The question is impossible to answer, but reasoning from past experience and considering the limited life of such structures and incidental losses, it is probably not an exaggeration to say that with passage of years, the original figures of direct loss will be duplicated.

Hydration and Failures

It should be understood, however, that hydration, or the lack of it, should not be held solely responsible for the production of poor concrete, with possible resultant failure. In this series it has been sought to emphasize the importance of other factors—*proper choice and proportioning of aggregates, sufficient mixing, proper consistency and care in placing.* There is more trouble traceable to neglect of these matters than to poor quality of cement; and although in this paper attention will be confined to the cement, these other factors should not be forgotten in considering the production of good concrete.

But effective hydration of cement is directly related to failure prevention. The removal of initial imperfections, such as voids, or poor contact of cement and aggregates, by swelling with hydration, is one of the most valuable properties of cement. The formation of gelatinous colloid by this process has before been noted. In its formation, large quantities of water are absorbed, but without net increase in bulk, as the swelled colloid occupies the space formerly taken up by the cement and water separately. If this should appear to be of minor importance, consider the point brought on in the paper preceding—*that each 62½ lb. of water-weight in a cubic yard of concrete means one cubic foot of space occupied by water; and that loss of this water by evaporation and seepage means one cubic foot of voids remaining.* Granted, however, the thorough hydration of a proper quantity of cement; not only would such voids be occupied by a dense, chemically-inert substance, not subject to the action of any natural water, but also their entrance, with resultant concentration of solution and disruptive crystallization of their salts, would be prevented. And to touch upon a point not previously considered, but one of the highest importance, *the fireproofing value of concrete is a direct function of the degree of hydration.* Extended experiments by C. W. Hunt at Sibley College in 1912 showed that the more effective the hydration, that is, the greater the colloid content in the cement mass, the lower the co-efficient of transmission of heat. Further experiments are needed along this line.

Experiments to Increase Strength

The property of strength, however, is that of most importance and interest to users of concrete. It is also the most easily determinable of all the properties of materials and the easiest of useful employment in the arts. Increasing the strength, tensile and compressive, was the primary object of this research; and before the nature of the lumps of cement found in mortars and concretes by microscopic investigation was known, it was believed that increasing the colloid through increasing the effective of hydration was the proper method of procedure.

To this end, it was first sought to secure intimate contact between cement and water by means of pressure, as in a wringer. This proved quite ineffectual. Drawing water through the mass by a vacuum was next tried, with the same result. Finally, after much experimenting, the apparatus shown in Fig. 33 was devised in 1912, with some rather successful results. Essentially it consisted of a container (B) from which cement was delivered by an air-boil, taking its air from the expansion tank (A); a water supply (E); a sand supply (D), delivered by a similar air-boil; a wooden receiver (F); and in the top of this receiver a nozzle, composed of a central delivery pipe for sand and cement, while surrounding it were eight throat atomizers, to finely divide the water supplied. It was believed that by these means, each cement particle would, in transit through the receiver, obtain its mating water-particle, with consequent promotion of hydration. A pan at the bottom of the receiver caught the wetted mortar.

MECHANICAL MEANS OF DISPERSION ABANDONED

Although decidedly crude in many ways, this apparatus was quite successful in operation, results being achieved by it that subsequent machines, more mechanically perfect and supposedly identical in operation, failed to secure on a larger scale. Although for a long time provocative of much labor and discouragement, it is now known that coalescing of water-drops, resulting from a multiplication of nozzles, intensified the surface tension effects, thus producing that grouping of cement particles which it was sought to avoid. In consequence, plans for mechanical dispersion had to be abandoned.

Many things appear simple in retrospect which were exceedingly complex during the period of their development. The determination of surface-tension as the dominating factor in preventing free access of water to cement required a protracted period of intensive study, but once this point was cleared up, the securing of more effective hydration became a matter of relative simplicity.

DISPERSIVE EFFECTS OF CHEMICALS

The dispersive effect of alcohol on groupings of cement particles has already been shown. Alcohol is, of course, not commercially applicable in the mixing of concrete, but it is not the only agent that might be employed. On the contrary, there are many such. Ether—also not commercial—is quite effective. Amyl. alcohol, though disagreeable to use, due to its unpleasant vapor, gives markedly superior results. A small percentage of a solution of Ivory soap is of considerable assistance, and among other materials that have experimentally aided may be mentioned sodium oleate, sodium hydroxide, potassium hydroxide and sodium carbonate (washing soda) and—strange as it may seem, sodium sulphate—that arch-enemy of sea-water concretes.

The use of these sodium alkalis and soaps was first suggested by a consideration of the density of those earths in which they are present in considerable proportion. It is not improbable that their influence as deflocculators has had an effect in the normal deposition of these earths. It is also interesting to note that the same agents are used in the preparation of clays for pottery work, where it is desired to have an evenly-wetted paste—an operation physically identical with the wetting of cement, but favored by the absence of chemical reactions that cause the binding together of particles by intercrystalline formations. There are doubtless a host of other materials which would serve the same purposes, but these mentioned are those on which experiments have so far been conducted.

Preliminary results obtained by their use are plotted in Fig. 34. These are interesting and promising, indicating what may be accomplished once the right proportion of the proper additive is discovered. Of necessity, it must be cheap in first cost and of a nature such that no detrimental effect shall be exercised through its agency. It is desired in this paper to present tentative results on mortars only, reserving longer-time experiments on concretes of varying proportions for later publication. But in view of the seeming correctness of the reasoning on which their conduct was predicated, and of the confirmation these favorable results afford, they are made public at this time in order that as wide an appeal as possible may be made for co-operation along these lines by all who are interested in the betterment of concrete and the growth of the industry. The subject is too vast and of too great import to be developed adequately by a single experimenter. The secret of accomplishment lies in organized effort by many, in order that inadvertent individual errors may be eliminated and the truth ascertained. It may be that rich rewards will fall to the lot of some fortunate investigator who shall perfect a patentable process, but for the present, the question belongs to the world and such information as is at hand is freely given.

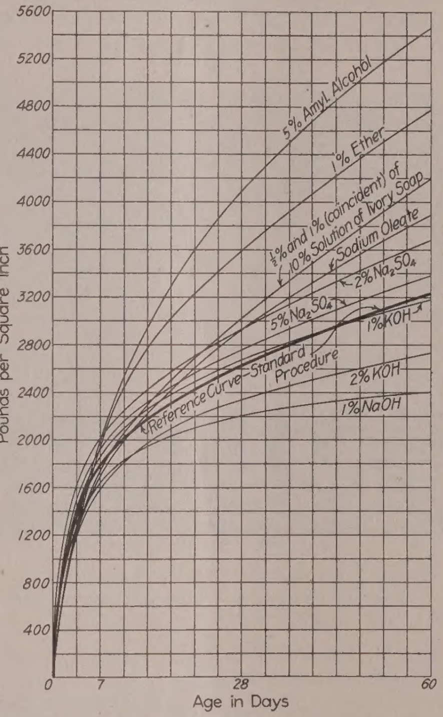


FIG. 34—EFFECT ON STRENGTH OF ADDITIONS OF VARIOUS DEFLOCCULATING CHEMICALS

SURFACE TENSION LOWERED BY HOT WATER

But perhaps most interesting of all are the results obtained by the use of *hot water* in mixing concrete. Surface tension is a function of boiling point. A liquid of low boiling point, like alcohol, or ether, has a low surface tension. In the same way, a liquid such as water, when elevated in temperature near to its boiling point, has a low surface tension. Furthermore, chemical reactions are speeded up, approximately as the twentieth power of their absolute temperature—a fact finding its expression in the subject in hand by the almost instantaneous reaction and formation of crystalline compounds, resulting, as is so well known, in immediate set, when cement is gaged with hot water. Expressed in tabular form, and taking 60 deg. Fahr. as a base, the time required for chemical reaction varies with temperature as follows:

Temp. Fahr.	*Time Required for Reaction*
60 degrees	1 (base)
70 "	0.69
100 "	0.23
150 "	0.049
210 "	0.0062

If, therefore, by some means, the formation of initial set could be prevented, gaging the cement with water at 210 deg. would not only result in a reaction 16,000 times as fast as that obtainable at 60 deg. Fahr., but would have the further advantage of reducing the surface tension factor so low as to be highly advantageous. Practically this instant set can be prevented by mechanical stirring and the effect of these hot-water additions as exhibited by photomicrographs and by physical tests are shown as in Fig. 35.

Although it is desired to warn against unwarranted conclusions as regards degree of hydration being drawn from these photomicrographs, the appearance of (b) mixed with water at 150 deg., age of specimen 28 days, is especially pleasing in the apparently large colloidal content, as shown by the prevalence of structureless white masses. It should be further noted that in this photograph, the voids are relatively smaller than in the others and of uncertain outline, indicating the gradual filling of pores by colloid in the manner before indicated.

In interpreting these photographs the relative percentage of cement-particle groupings is first to be noted. In (a) where the mixing water was at 100 deg. Fahr., these groupings are quite extreme. Evidently the surface tension was not sufficiently lowered by this rise of temperature to offset the accelerated chemical reactions producing the interlacing of grouped particles. The tensile strength of this briquette at 28 days was 772 lb. per square inch.

With the mixing water at 150 deg., the grouping is a minimum, with prevalence of white, cloudy patches, indicating a large percentage of flocculent colloid, and confirmatory of this is the lower tensile strength of 640 lb. per square inch, for the strength of colloid is not developed until the passage of considerable time, while the strength of crystalloids, as in the groups shown at (a), is developed almost instantaneously.

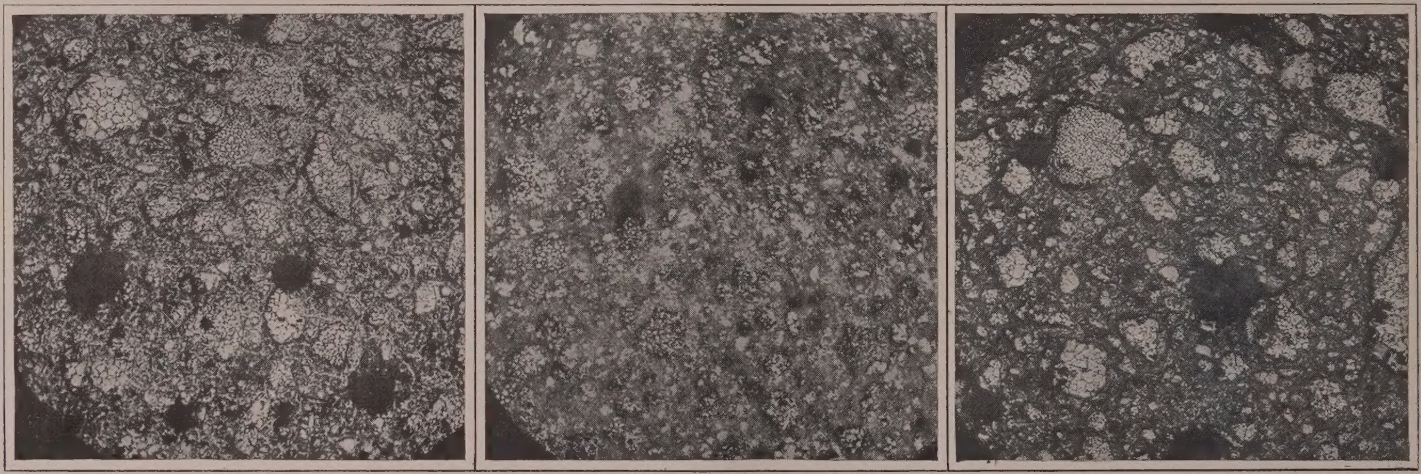
In (c) is shown a briquette made with the mixing water at 200 deg. Fahr. The groupings are in goodly number, though not excessive; and the colloid content is probably larger than in (a), for the tensile strength is 715 lb. per square inch—midway between the others. There is very probably a critical temperature at which the best results would be obtained, but what this temperature is has not yet been determined. It is of course possible that the differences here shown are attributable to manipulation, but as all briquettes were made by the same operative, this possibility is assumed to be negligible.

These experiments and their results seem to find confirmation in the superior quality of concrete often made from heated aggregates in cold weather. A number of observers have noted this.

WETTING SURFACE OF AGGREGATE

There is also another highly desirable result attainable through lowering the surface tension of mixing water. The reluctance of water to wet a dry surface, such as that of aggregate, is well known. Liquids of low surface tension, such as alcohol, or water containing such substances as the sodium alkali used in the mortar experiments before noted, do not exhibit this reluctance, but on the contrary, pass freely over a dry surface with eagerness, as though there were affinity between them.

In the paper on the proportioning of aggregate (Engineering Record, Feb. 13, 1915), it was pointed out that where pieces of large aggregates had been dislodged from their bedding in the mortar of 8-in. sections, there was every evidence that thousands of air bells, if not an almost complete envelope of air, had clung to the surface of the aggregate, preventing contact between cement and aggregate; and it is to be inferred from such instances that similar conditions obtain throughout the mass. In micro-sections as in Article 1 (Engineering Record, Jan. 23, 1915), the same conditions were shown to obtain with a sand grain; and it requires but little thought for anyone to realize that this occlusion of air is another manifestation of the effect of surface tension of water; and corollary to this that the reduction of the mechanical value of this surface tension is one way, if not the only way, of overcoming such difficulty. Further, since these air bells and air films occupy space in the mass, it follows that their removal would strengthen concrete, not only by replacing air with material of high strength, but also because such removal would permit a closer compacting of aggregates, with all the consequent advantages accruing to the production of a substance having a density approaching more nearly that of natural stone. Just as defects are cumulative in their pernicious effect, improvements are in like measure valuable. Concrete is a composite substance; and only by having regard for the natural properties of its component materials, not the least important of which is water, may proper results be obtained.



(a) Strength at 28 Days, 772 lb.

(b) Strength at 28 Days, 640 lb.

(c) Strength at 28 days, 715 lb.

FIG. 35—PHOTO-MICROGRAPHS SHOW CHARACTER OF MATRIX OF NEAT BRIQUETTES TESTED IN TENSION; 50 DIAMETERS

WIDER STUDY NEEDED

In the six papers of this series it has been sought to place before the engineering world at large certain considerations, old and new, in regard to concrete in such sequence and relation as to show their importance, not only individually, but collectively as well. Necessarily the treatment of each phase of the question has been brief, but it is hoped that some suggestions have been made such that further investigations as to the undeveloped possibilities of concrete will be carried out by others.

Valuation Conference in Washington March 22

Interstate Commerce Commission Will Hear Carriers Discuss Many Questions in Connection with Government Appraisals

A VALUATION conference will be held in Washington beginning March 22 at 10 a. m. The Division of Valuation of the Interstate Commerce Commission has virtually completed its appraisals of a number of railroads, and in the prosecution of the work a large number of questions have come up which the commission believes can best be answered at a hearing in which all carriers, as well as representatives of the State commissions, will have an opportunity to take part. The questions cover practically every phase of the subject, and are not peculiar to any particular railroad. The commission hopes that the week will be found sufficient to exhaust the subject.

Preliminary reports, states the announcement from C. A. Prouty, director of valuation, are substantially ready for submission to the Interstate Commerce Commission in case of several carriers, including the Atlanta, Birmingham & Atlantic, the Norfolk Southern, the Texas Midland, the New Orleans, Texas & Mexico, and portions, if not the entire line, of the San Pedro, Los Angeles & Salt Lake Railroad. The prices applied in these reports are not final, but are given subject to correction; in other respects the reports as presented to the commission will represent the final conclusion of the Division of Valuation.

These reports will present many questions of fundamental and far-reaching importance, which must be finally passed upon by the commission. It has, however, been thought desirable to bring on a conference between representatives of the carriers, State commissions, and those having immediate charge of this work on the part of the Interstate Commerce Commission, before the final form and substance of the reports is determined upon, with a view to discussing some of the matters which must finally come before the commission. Such a conference has therefore been called for Monday, March 22, at 10 a. m., in Washington. It is not proposed at that time to consider matters of detail peculiar to the particular roads under discussion.

QUESTIONS TO BE CONSIDERED

Among the questions which will be considered are the following:

1. The form and manner in which the report shall be presented to the commission by the valuation division and by the commission to Congress.

(*a*) What detail should be furnished Congress for the use of itself and the public?

(*b*) What detail should be served upon carriers and State commissions and other interested parties by the commission in order that the conclusions of the report may be properly checked up and verified?

(*c*) How should the report be prepared, to the end that it may be kept up to date by the Federal commission and also by State commissions, if desired? Shall the valuation section used in Federal and State valuation be the same?

In this connection consider what is meant by each "piece of property" as used in the first paragraph.

2. In determining "cost of reproduction new," to what extent shall reference be had to conditions as they existed at the time of the original construction?

(*a*) Shall an allowance be made for clearing and grubbing, and if so, shall it be allowed where the road runs through what is now tillage land, but what was at the time of construction a forest?

(*b*) The road runs through an orchard which did not exist at the time of original construction. In determining cost of reproduction new, shall the value of the land be determined with or without the trees?

(*c*) A building was wrecked when the road was constructed. Is the expense of the wrecking to be included in the reproductive cost?

(*d*) Are present geological and topographical conditions to be taken, or is inquiry to be made as to what these conditions were at the time of original construction?

(*e*) Shall it be assumed that present transportation facilities are in effect, or must reference be had to such facilities as existed when the road was constructed?

3. Shall the road be reproduced in the form and manner in which it was originally built?

(*a*) For example, gravel was brought from a considerable distance in point of fact, but a gravel bank is to-day available at much less cost. Shall the road be allowed the haul which was actually made?

(*b*) The rail originally laid was relay. In determining cost of reproduction new, shall we apply the relay price or the price of new rail?

(*c*) The rail now in branch lines or sidings was originally laid new in the main track and taken from there to the branch or siding. Shall this be treated as new rail and priced and depreciated accordingly, or shall it be treated as relay rail when laid?

4. What overhead charges shall be allowed and in what amount? By overhead charges are meant items like engineering, contingencies, interest, taxes, etc. How shall the time necessary to reproduce the property be determined?

APPRECIATION AND DEPRECIATION

5. Shall allowance be made for appreciation; and if so, as to what parts of the property? Shall account be taken of solidification and adaptation; and if so, shall this be by the addition of a percentage to all grading quantities?

What allowance, if any, shall be made for shrink or swell in determining quantities as shown by actual measurement in present embankment, and shall this allowance be made by reference to local conditions or by some uniform per cent?

6. How shall depreciation be determined?

(*a*) By mortality tables? If used, shall these be general or made with reference to the property of each carrier?

(*b*) By actual observation?

(*c*) By combination of these two methods? If by combination, what weight shall be attached to age and what to the observed condition?

(*d*) Shall obsolescence and inadequacy be considered?

7. How shall unit prices be determined? If for an average period, what shall that period be and shall it be the same for all railroads, no matter as of what date they are valued?

What allowance shall be made for the cost of transportation of men and materials over the line of the carrier itself while under construction?

LAND QUESTIONS

8. How shall the "present value" of lands used for transportation purposes be determined?

Shall the cost of acquiring the right of way at the present time be determined and stated as a part of the cost of reproduction new?

The act calls for "the present cost of condemnation and damages in excess of present values of lands." What is the meaning of this phrase and how shall the information called for be arrived at?

What is meant by "terminals" as used in the second paragraph?

9. When are lands "owned or used" for common-carrier purposes? Should lands in any case be classified as held for common-carrier purposes unless they are actually so used?

When are lands "dedicated" to the public use?

10. When original cost cannot be shown from the books of the carrier, shall an estimate be made?

11. Is it the duty of the commission to distribute the value of equipment between different States; and if so, upon what basis shall the distribution be made?

Shall the value of a great terminal like, for instance, the Pennsylvania passenger station in the city of New York, be distributed; and if so, upon what basis?

WHAT ARE OTHER VALUES AND ELEMENTS OF VALUE?

12. What are the "other values and elements of value," if any, which should be reported in addition to original cost, cost of reproduction new, and depreciation? Shall, for example, allowance be made for going value, franchises, favorable location, earning capacity, etc.?

13. Is the duty of the commission completed when it reports to Congress cost of reproduction new, cost of reproduction new less depreciation, original cost to date, and other elements of value, or must it go further and state from a consideration of the facts which it reports, a value for the property itself? If so, what weight is to be given to the several facts reported and to any other facts which the commission may report in connection with financial history, abandoned property, donations, etc.?

It is suggested, in order to economize time, that the railways and the State commissions select some one or more persons to present their views on each topic, and that such conference be had before the opening of the discussion as will enable the persons selected to present fully the views of those for whom they speak. The conference will continue until the subject has been exhausted, but it is hoped that the week will be found sufficient for this purpose.

Concrete a Plague-Eradicator in New Orleans

Repairs to Waterfront Structures and City Buildings Resorted to as Starvation Measure for Rats Which Transmit Disease

By H. P. LETTON

Sanitary Engineer, U. S. Public Health Service

CONCRETE is the weapon which the city of New Orleans is using effectively in its campaign against infected rats, which have been responsible for the spread of bubonic plague in that locality. Plans involving the expenditure of $750,000 for the repair of docks, waterfront terminal buildings, and other structures—the object being to cut the rats off from their food supply—have been accepted by the board of port commissioners and in this fight against disease one of the most widely used materials of engineering construction occupies a prominent place. Thus the campaign for health is one which depends for its success as much upon the engineer as upon the medical man.

It has been definitely proved that bubonic plague is transmitted only by the bite of several species of flea which infest the rat and other similar rodents. The problem of the eradication of plague comes down to an intensive warfare on the rat. This is accomplished in two general ways—first, by trapping and poisoning, and, second, by rat-proofing. The high birth rate of rats makes trapping and poisoning ineffective for obtaining permanent results. In order to successfully eliminate the rat it is absolutely necessary to cut him off from his food supply. This is accomplished by the second method mentioned—rat-proofing.

RAT-PROOFING METHODS

By rat-proofing is meant in general the construction of new structures and the remodeling and repair of old ones in such a manner as to prevent the harboring or breeding of rats and their access to food. This result is attained in brief as follows: The ground area of the structure must be covered with some material impervious to rats, usually concrete, and have walls of the same or similar material extending to a depth of at least 2 ft. into the ground. In frame buildings with double walls this foundation wall must extend to a height of 1 ft. above the floor level except at natural and necessary openings such as doors. Wherever practicable ceilings should be removed, leaving the joists exposed in order to prevent rat harboring. All natural and accidental openings should be made rat tight or closed entirely.

In dwellings or other buildings where food is not manufactured, stored or sold, it is allowable for economic reasons to rat-proof by elevation. The purpose of elevation is to allow entrance of light to the ground beneath the building, thus making it unfavorable for the burrowing of rats. Elevation only is not rat-proofing. By elevation is meant raising of the building on piers so that the distance from the most dependent timber to the ground will be at least 2 ft. In this construction the spaces between the studding must be filled with material impervious to rats to a height of at least 1 ft. above the floor level. All of the precautions in regard to openings mentioned above must also be taken in this case.

Buildings used for residential purposes only may in lieu of concreting the ground area or elevation, be rat-proofed by constructing a wall extending for 1 ft. above the floor level to a depth of 2 ft. into the ground, and entirely enclosing the buildings, with no openings except for ventilation, and such openings must be tightly screened.

ORDINANCES NEEDED

In order to carry on successfully a campaign of rat-proofing the first essential is an ordinance requiring that all buildings, old and new, be rat-proofed, and stating in more or less detail just how it shall be done. Such an ordinance was put into effect in New Orleans early in the work.

New Orleans is a city of about 400,000 population spread over a considerable area in which the majority of buildings are of frame construction. For the purpose of the campaign the city was arbitrarily divided into seven districts, each of which acts as a unit in carrying out the work. Each district is in charge of a commissioned officer of the Public Health Service. To the writer was assigned the problem of devising a means for rat-proofing the waterfront and the probable cost thereof. To him also are referred various engineering questions which come up from time to time. The work as a whole is under the direct charge of Assistant Surgeon General W. C. Rucker, with Surgeon R. H. Creel as executive officer.

The material most generally used for rat-proofing is concrete since it is impervious to rats and because it is permanent construction. Probably the greatest trouble in connection with the New Orleans work has been to get concrete of a satisfactory quality. The amount of work to be done was so great that the regular contractors were soon swamped, and as a result men of little experience and less scruples purchased a shovel and wheelbarrow and called themselves contractors. These wholly inefficient men have been the bane of the district officers' existence because they skimp their work wherever possible and because they really do not know how to do good work.

Amount of Concrete Work

An idea of the amount of concrete work being done can be seen from the fact that since Oct. 3, 1914, when the records of such work were started, 314,000 sq. yd. of concrete, at least 3½ in. thick, has been laid. Another way of expressing this is that enough has been placed to build a concrete sidewalk 3 ft. wide and 178 mi. long. Most of this has been in comparatively small units scattered over the whole city. There had been up to Feb. 13, 1915, 21,346 buildings rat-proofed, and the work is proceeding at the rate of about 500 buildings per week.

The rat-proofing of the railroad freight stations and warehouses, which are among the largest pieces of work to be done, is being carried on consistently. This work is in many cases proving to be of considerable economic benefit to the companies involved. In one instance the concrete floor in a freight house cost the railroad about $10,000 to construct. Since the improvement was made it has been estimated by the superintendent that the saving in labor of trucking over a smoother floor will amount to about $5000 per year, or enough to pay for the work in 2 yr.

Docks the Biggest Problem

The biggest rat-proofing problem in the city is that of the docks. These are timber and pile structures covered for the most part with steel sheds and extending about 6 mi. along the river. The sheds generally rest partly on the wharf proper and partly on the levee in the rear. As now constructed they have all the essentials which go to make a rat's life a happy one. The wharves are especially important for the reason that plague almost always enters or leaves the city through its water front. Plague-infected rats have been caught in New Orleans at numerous points along the river front, thus emphasizing the need of making these structures rat-proof.

Cleaning Rough Pavement requires approximately 30 per cent more labor than is required to clean a smooth pavement, according to figures compiled by the Chicago Citizens' Street Cleaning Bureau.

Pennsylvania's Concrete Bridge Over the Susquehanna

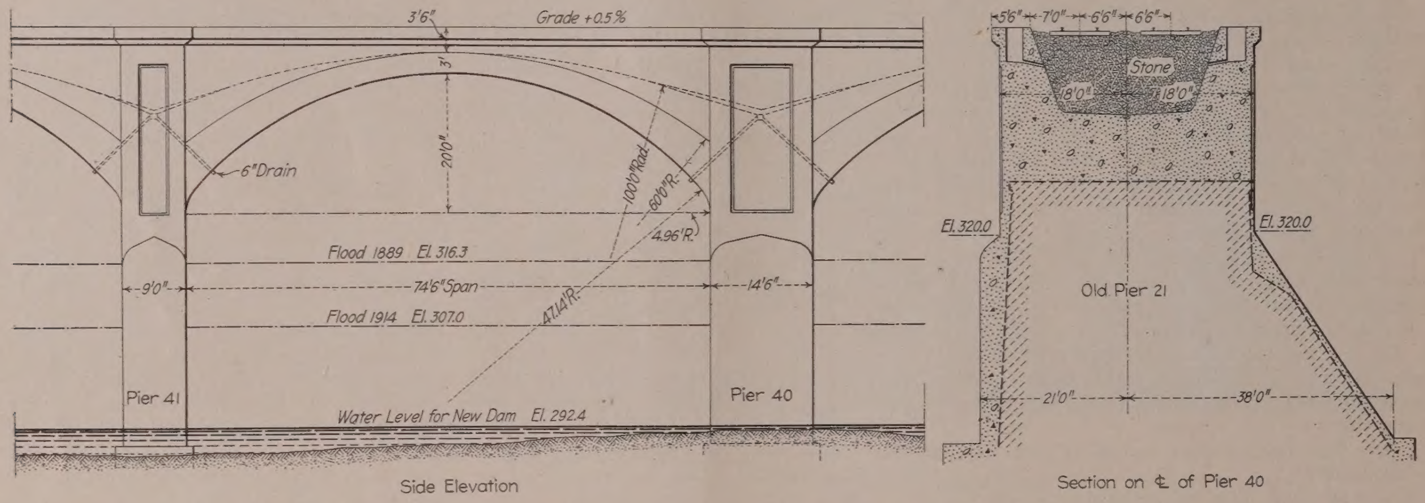
Arched Structure, 4000 Feet Long, Will Replace Single-Track Cumberland Valley Twenty-five Span Crossing and Will Cost $750,000

THE FIRST construction work of magnitude undertaken by any of the lines of the Pennsylvania system for more than a year is the new concrete arch bridge over the Susquehanna River at Harrisburg, just being started by the Cumberland Valley Railroad. The new bridge will cost approximately $750,000 and will replace the present steel deck truss bridge, which is a single-track structure of twenty-five spans, supported by stone piers.

The proposed bridge will utilize the present piers, which will be enclosed by new concrete, and will require the construction of a number of additional concrete piers, the foundations being carried down to rock, which is practically at the level of the bed of the river at this point. The foundations up to about 1 ft. above normal water level have been completed by the forces of the Cumberland Valley Railroad, and the balance of the work will be placed under contract within a short time. Bids have been advertised, and will probably be opened about the middle of March.

Arches Designed as Plain Concrete Rings

The new bridge is nearly 4000 ft. long, and consists of forty-five plain concrete arches each of about 75 ft. clear span, and one 70-ft. through girder span over the low-grade line of the Pennsylvania Railroad near the western end. A typical span is shown in the accompanying figure. The arch ring proper is 3 ft. thick at the crown and about 10 ft. thick at the springing line, much heavier than would appear from the outline showing on the face of the structure. A small amount of reinforcing steel is used to provide for temperature stresses. It is seen that the intrados is a simple circular arc for the greater part of its length, with short end arcs of small radius. The rise of 20 ft. is between one-third and one-quarter of the span, and it will be noted that the backfill is a stone ballast supporting the ties for the double-track road. Drain pipes placed over the piers carry off all accumulating water, which is led to these pipes by proper transverse slopes, as shown.



Side Elevation

Section on ℄ of Pier 40

TYPICAL CONCRETE ARCH SPAN FOR PENNSYVANIA'S NEW BRIDGE OVER SUSQUEHANNA RIVER AT HARRISBURG

As the masonry piers of the present bridge were originally constructed to provide for two tracks, it will be possible to move the present track over to one side of these piers and continue the operation of trains over the old bridge while one-half of the new arch bridge is being constructed. Then the traffic will be diverted to this new portion, and the other half completed.

In connection with this construction, the Cumberland Valley Railroad will build under-grade crossings at Front and Second Streets in the city of Harrisburg. The grades of these streets have been depressed and concrete abutments constructed to support solid-floor steel bridges, which will be covered with concrete in ornamental design. The result of this work will be the entire elimination of all grade crossings of the Cumberland Valley Railroad in Harrisburg.

This work is being done under the direction of A. C. Shand, chief engineer, and H. R. Leonard, engineer of bridges and buildings of the Pennsylvania Railroad.

Oregon Methods for Obtaining Service Data on Concrete Roads

CONCRETE bench marks are set on Oregon State concrete road work near the edge of the right of way at different places along the highway where conditions or materials change. For example, where the wearing surface changes from a 1:2 mix to a 1:1:2 mix, a bench mark is set and the elevation stamped upon it.

On the pavement, at points 10 ft. each side of the expansion joints, a soft copper wire is set 6 in. from the edge of the pavement. Measuring from this wire exact elevations, read to thousandths, are taken every foot across the pavement. The object of the wire is to locate definitely a point which can be found at any future time for reference with respect both to longitudinal and transverse measurements. In years to come it will be possible and easy to check the amount of wear on the pavement to within a thousandth of an inch. Having the two measuring points so close together and under the same working and traffic conditions, but with different materials will, it is figured, make it possible to determine the merits of the materials, mixes and cements used.

Exact records of every contraction crack are kept. The shape, dimensions and notable features are all drawn to scale.

Grade-Crossing Law and Its Effect on Grade-Crossing Elimination

Town and State Should Share Expense—Fixed Percentage Basis on Entire Work Conducive to Best Solution of Most Separation Problems

By C. W. STARK
Associate Editor, Engineering Record, New York City

GRADE-CROSSING elimination is a subject of ever-increasing importance. At the same time the whole question of a just and rational way of providing for such work and dividing the expense equitably is in a state of chaos. Except in a few Eastern States where there has been some attempt at a percentage basis, the railroads are at the mercy of the States and municipalities they traverse. The railroads patiently eliminate grade crossings as ordered, make such dickers as they can to lighten or offset the financial burden, and pay the entire cost if they can do no bargaining; and through it all the engineering officials seem to display an apathy as to the possibility of some better arrangement, and even ignorance as to what is actually being done in a few sections of the country. Where there are few demands for the separation of grades the money involved is not excessive, but it may be taken for granted that these demands will constantly increase in numbers, and it behooves railroad officials to "get together" on this point, work out desirable standards of procedure and diligently urge them upon the attention of legislators. The chief purpose of this article is to emphasize what can hardly be disputed, that fairness demands the participation by municipality, State or both in the expense of grade-crossing elimination; and to show that a systematic and continuous program, with the object always in view of solving each individual problem in the best way, can best be carried out by a fixed proportionate division of *all* of the expense.

EXISTING LAWS

Approximately twenty States have no laws whatever touching upon grade separation. These are mostly Southern States and the less populous Western States. In nearly as many more the public service commission is empowered to fix the division of expense. The New England States, with the exception of Rhode Island, together with New York, New Jersey, Virginia, Ohio and Indiana, are, so far as the writer has been able to ascertain, the only States in which a definite attempt has been made to fix the proportions, and no two of these agree as to those proportions. The accompanying table shows the wide divergence of proportions in these ten States.

There have also been a variety of special arrangements made between railroads and individual cities, some of them on a fixed percentage basis, others on the plan of having each of the parties concerned do and pay for part of the work.

Obviously in the thirty-seven States in which it is left with the commission to apportion the expense, or in which there is no law governing, the railroads are in constant uncertainty as to what they may be called upon to do and how much the work will cost. Unless they can see material benefits ample to justify bearing the entire cost, or have in view some concession desired from the municipality, they have every incentive to hold back and hope to be let alone. In many of these States there are comparatively few of the most dangerous grade crossings and the situation is not yet acute.

RAILROADS SHOULD NOT PAY ALL

The unfairness of the New Jersey and New Hampshire laws need little comment. Regardless of alleged charter rights or restrictions, the lawmakers of these States should recognize that in the earlier days of railroading grade crossings were an economic necessity and were not especially objectionable, that the changed conditions are the natural consequence of the growth of the country and the development of the art of railroading, and that the railroads should not be forced to bear the entire cost of non-productive improvements. It may be taken for granted that so long as these laws stand they will be fought at every turn by the carriers, and that many a danger spot that would under a fair plan be speedily removed will remain for years to come.

In this connection it is noteworthy that bad as the present New Jersey law is, a worse one has recently passed the State Senate. Under the present law it is left with the State Board of Public Utility Commissioners to determine which crossings shall be eliminated, and this board has refused to issue elimination orders blindly. The new bill demands that one crossing be eliminated each year for every 30 mi. of track operated by each railroad. It is similar to the one vetoed by President Wilson when Governor of the State, and if passed and rigidly enforced will doubtless send more than one small road to bankruptcy.

DIVISION OF EXPENSE IN THE TEN STATES THAT HAVE FIXED THE PROPORTIONS

State	Percentage of expense			Remarks
	Railroad	Municipality	State	
New Hampshire	100	0	0	
New Jersey	100	0	0	
Indiana	75	25	0	The county bears the 25 per cent.
Maine	65	10	25	State limited to $15,000 per year.
Vermont	65 or more 60 or more	Not over 10 Not over 15	Not over 25 Not over 25	Depending on priority of railroad or highway.
Massachusetts	65	Not over 10	Balance	Street railways interested may be made to pay not over 15 per cent.*
Ohio	65	35	0	
New York	50	25	25	
Connecticut	100 50 75	0 50 0	0 [illegible] 25	Depending on whether railroad, municipality or State initiates the improvement.
Virginia	100 50	0 50	0 0	Depending on whether the change is to be made in the railroad or the highway.

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*The State will not assume any share of the cost of eliminating any grade crossing established after June 21, 1890.

In Connecticut, where the distribution of expense depends on which party asks for the improvement, it is obvious that the railroad is not likely to do the asking. Lucky the railroad if the town petitions for the improvement! If it does not, and the commission of its own initiative orders the change the railroad is penalized 25 per cent, because the State is evidently not willing to shoulder the burden it readily imposes on either the railroad or the town. Co-operation is the key to a systematic program of grade separation, and the Connecticut plan is obviously fatal to co-operation. Each of the parties concerned will hold back and wait for one of the others to speak and pay the penalty therefor.

DISTRIBUTION OF ITEMS OF EXPENSE UNSATISFACTORY

Virginia distinguishes between changes in the railroad and changes in the highway. This is somewhat in line with the arrangements made in a number of cities, in which the railroad pays for certain parts of the work and the municipality for certain other parts. In Chicago, for instance, the railroads ordinarily pay for the trackwork and bridges, and the work in the street belonging to the city, while the city pays the consequential damages, and the corporations or individuals having interests in the street, such as pipes or wires, pay the cost of all alterations thereto. In a level, low-lying city like Chicago, where drainage is a great problem, all changes must virtually be above the present ground surface, and except where an isolated street crosses a large number of tracks, such as Twelfth Street, between Canal Street and Wabash Avenue, the only solution to the grade-crossing problem is to raise the tracks and depress the streets little if at all. Consequently the objections to the plan of payment do not stand out.

In a hilly city, however, it often requires much study to determine the cheapest and best way to effect the elimination. There are the possibilities of raising or depressing the tracks, raising or depressing the streets, or a compromise by raising the one part way and lowering the other a like amount. If the city pays only for the land, or for the land and the street work, it will naturally oppose changes in the street levels; yet if only one or two streets are involved it is usually far cheaper to preserve the track profile and raise or lower the streets the full amount. It is often possible to combine two or three crossings and carry them over or under on a new location in which the land damages are the principal item. Obviously, agreement as to the best of several feasible schemes is likely only if all parties are to pay fixed percentages of the cost of the entire improvement, exclusive of additional facilities, such as extra tracks for the railroad, or better pavements for the city, which should, of course, be paid for solely by the respective beneficiaries.

PERCENTAGE DISTRIBUTION BEST

Of the six States which relieve the railroads from part of the expense by a fixed proportionate distribution, it will be noted that Maine, Massachusetts and Ohio have set the railroads' share at 65 per cent, while Indiana charges them 75 per cent and New York only 50 per cent. Vermont charges the railroads at least 65 per cent, if the highway was there first, but the municipality and the State's shares are to be fixed at not more than 10 and 25 per cent respectively, and evidently the railroad must make up the difference. Vermont also distinguishes between priority of the railroad and that of the highway. This is good in theory, but owing to the difficulty of determining in many cases which was there first it is probable that general recognition of this distinction would lead to prolonged litigation.

These six States disagree decidedly as to who should pay the public's share. Ohio and Indiana decline as States to shoulder any of the expense, but impose a goodly percentage on the municipality or county. The New England States think 10 per cent enough to impose on the town, but shoulder 25 per cent themselves when there is no street railway to relieve them. New York thinks it equitable to charge a considerable part to both municipality and State, making the railroad pay only one-half.

NEW YORK'S PERCENTAGES WORK WELL

The writer believes that the New York proportions are the fairest, and that they work out to the best practical advantage. The danger of grade crossings is due chiefly to the carelessness of the public in disregarding warnings, and seemingly the railroad is doing its share when it pays half the cost of removing this danger. Generous participation by the State is fully in keeping with established policy, whereby States aid in road building and the Government improves navigable waters where the benefit is mainly local. That the 25-per cent levy works hardship in certain cases on poor municipalities can not be gainsaid, but experience has shown that while a few towns have fought these changes in the courts, more have joined the railroads in applying to the State to have the improvement carried out.

It is noticeable that when the percentage basis is used, sparsely settled communities in hill districts, where mud roads on 15-per cent grades prevail, do not demand nickel-plated boulevards on level grades at railroad intersections, as is sometimes the case where the railroad bears the entire cost. Usually the municipality is willing to pay its fourth for something just a little better in the way of pavements and grades than the railroad suggested in the original plan—something just a little better than the surrounding pavements and grades. As yet little demand for the artistic has been shown in these improvements, and usually the communities are satisfied with the utilitarian bridges, walls and fences proposed by the railroads. In Buffalo, however, where the grade-crossing problem was taken up before the State law was passed, and where special percentage arrangements, agreed upon for each group of crossings by the railroad and the Buffalo Grade Crossing Commission, are in effect instead of the State law (except at certain new crossings), much attention has been given to appearance in certain parts of the city, the city willingly paying its share of the additional cost.

STREET-RAILWAY PARTICIPATION

Nothing is said in the New York law about participation in the expense by street railways occupying the streets. In Massachusetts and Connecticut the public service commissions are empowered to impose as much as 15 per cent on the street railway. In cities where the work is done by special agreement the street railways usually participate, the percentages varying up to about 25 per cent. How much the trolley company should pay, and how such payment should affect the percentages of the other participants, involves many nice questions. The trolley company may say that it is paying its share indirectly as a taxpayer, contributing heavily to the city's share, and that it derives little if any benefit from the improvement. The steam railroad will cite that it also pays taxes, and that it is unreasonable for it to be put to extra expense in providing heavier girders to carry electric cars on overhead crossings, or in increasing clearance in subways, while the cause of the extra expense, perhaps itself a competitor of the steam road, contributes nothing. From the steam railroad's point of view the equitable arrangement is to levy a percentage of the entire cost on the street railway and deduct proportionally from the percentages of the other parties, or to charge the street railway the amount of the extra expense involved and pay for the remainder of the work on the usual basis. On the other hand, the city may hold that as the trolley company occupies a part of the street, whatever the company pays should be deducted from the city's share.

DEFECT IN NEW YORK LAW

In prosecuting grade separation under the New York law the railroad handles and pays for the construction, while the municipality handles and finances the land and damage matters, being better able than the railroad to make reasonable terms with obdurate property owners. The State pays nothing until the improvement is completed and accepted. Therein lies probably the worst defect in the New York law—the obstacle in the way of a continuous program of grade-crossing elimination. The State public service commissions can order work only when the State has unattached funds to pay for its share, and these funds must be specially appropriated by the Legislature.

After an order is given for a large elimination, based on a general plan and estimate, it may take a year to work out the details to the satisfaction of all parties concerned, prepare the specifications, obtain suitable bids and reach the point where actual construction may begin. The construction work may take two or more years. Minor changes, to make the improvement satisfactory to all parties, may delay another year the final acceptance of the work. All this time the State must have had the money virtually set aside for this final accounting. With a number of these improvements under way the money thus held in abeyance may amount to a large figure, and Legislatures have been prone to regard this amount as ample for all needs, overlooking the fact that it was already allotted. In consequence, the appeals from the public service commissions for liberal appropriations are repeatedly ignored, and in several instances such meager sums as the Legislatures have yielded have been vetoed by the Governors.

The remedy is not clear. Looking at the question with the one thought of keeping up a continuous program of the much needed work, it would be ideal if the State could turn over to the railroad and the town at the outset, say, 75 per cent of its share of the estimated cost. For the State to pay as the work proceeded would be less desirable, as it would involve constant accounting difficulties and would leave more money behind at all times to delude short-sighted lawmakers. Possibly the State, like the railroad and the town, could handle and finance a certain part of the work. The writer does not know what constitutional or political difficulties might make impracticable these plans—State partnership in improvements unfinished or unstarted—but believes that any of them, by withdrawing most of this "dead" money from the sight of the legislators, would show up the need for larger appropriations. Grade separation could then go on in greater volume and with more regularity and the railroad departments handling it, knowing what to expect, would be more stable and uniform. They would thus be able to put more skill and efficiency into the work, and there would be the greatest amount of elimination accomplished in the best way.

NEW CROSSINGS AND PROTECTION OF OLD

The foregoing applies solely to existing grade crossings. Even New York State is not so fair when it comes to new crossings. If the newcomer be the railroad, it must pay the cost of all crossings, whether at grade or not; grade crossings are allowed in numerous instances, but are looked at askance. In the case of new streets opened and carried over or under the railroad the municipality and the railroad each pay 50 per cent. Nobody will question the propriety of making the new railroad pay the full cost of whatever it builds. It is not clear, however, why the railroad should pay as much for the new crossing as for eliminating the old, while the State goes entirely free. The State should not unload its entire burden on the town without transferring a similar amount from the other involuntary party to the proceeding—the railroad. In fact, it might be argued that as the railroad pays the whole cost of its new crossings the town should do the same. But the railroad would probably not fight over the payment of 25 per cent for the town's new crossings. If the State thinks the remaining 75 per cent is too big a load for the municipality let it apply the State-aid principle and share the burden.

Carrying the idea still further, the writer wonders why the railroad should be compelled to pay the entire cost of protecting existing grade crossings. As already suggested, the chief danger of the grade crossing lies in the fact that mankind will not heed visible and audible warnings. Of course there are accidents caused by failure of gongs to work, of gates to come down in time or of flagmen to attend to business. In addition, there is the nuisance caused by the blocking of streets by trains. To relieve the railroad of too much of the cost of protecting the crossing would be undesirable, as it would destroy the railroad's incentive to separate the grades; cold figures often show that the annual cost of maintaining and protecting the grade crossing is more than the interest on the railroad's share of the cost of eliminating it. On the other hand, the payment by the municipality of a small part of the cost of protection would serve two good ends; it would discourage the promiscuous ordering of unwarranted protective devices and give the town a little more incentive to co-operate in eliminating the danger spot. The writer believes the payment by the municipality of 15 or 20 per cent would effect a good balance.

SUMMARY OF CONCLUSIONS

Summarizing, the writer believes:

1. That the absence of any grade-crossing law means increasing chaos as grade cross-

ings become more and more dangerous.

2. That the situation is only slightly mitigated by leaving to the public service commission to decide in each case as to the distribution of the expense of elimination work.
3. That to compel the railroad to bear the entire burden is indefensible.
4. That a flexible percentage basis depending on which party raises the issue is fatal to the necessary co-operation.
5. That only a fixed percentage division of the entire expense will lead to the best solutions of all grade-crossing problems.
6. That the New York percentages as applied to existing crossings—50 for the railroad, 25 for the municipality and 25 for the State—are equitable and conducive to a vigorous program of grade separation.
7. That a number of points are involved in the question of participation in the expense by street railways affected by grade separations, and should be given careful consideration.
8. That a plan should be devised for using the State's funds approximately as fast as they are available, so that legislators will not be misled by the balance, already assigned to definite improvements.
9. That railroads should not be required to pay more than 25 per cent of the cost of opening new streets over or under the tracks.
10. That municipalities should pay a small percentage (not to exceed 20 per cent) of the first and annual costs of protecting existing grade crossings.

Device Tests Adhesiveness of California Road Oils

Apparatus Consists of a Journal Lubricated with the Oil Under Test and Operated by a Constant Pull of a Given Weight

By maintaining a laboratory at Sacramento in which tests of cement, sand, stone, gravel, oil, asphalt, and other materials employed in the construction of highways are made, the California Highway Commission is able to ascertain what materials are suitable for use before actual construction on any part of the system is started. It also may standardize construction work by making tests of occasional samples from different contracts.

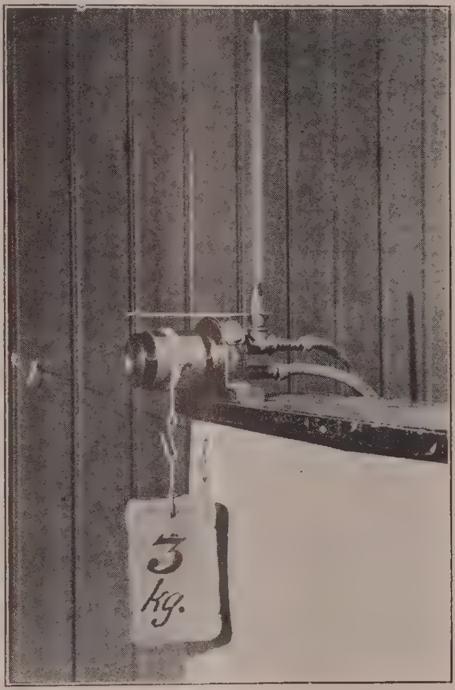
Samples are usually sent to the laboratory for examination, but where this is impracticable, field tests are prescribed. Further, field tests are made of the grading of sand and gravel, and, in addition to tests at the mills, accelerated tests are made of each car of cement.

The standard type of road constructed by the California Highway Commission is a permanent concrete base protected by a wearing coat composed of a heavy asphaltic road oil and screenings. The screenings are either coarse sand or crushed rock, or both, and make a wearing surface about $\frac{3}{8}$ in. thick. This type of wearing surface on the trunk line between Fresno and Stockton has been in service for $1\frac{1}{2}$ yr., carrying heavy traffic, and is reported to indicate as yet no serious wear.

The road oils used, which contain about 90 per cent of 80 penetration asphalt, are tested for the asphalt content, for volatility, flash and burning points, solubility in carbon bisulphide and carbon tetrachloride, and for percentage of water and sediment. Early in the work it was found that little information was gleaned from all these tests as to the actual physical properties of the oils, although it was pointed out that both the viscosity and adhesive or binding property of the oil are of the greatest importance in road building and must be kept within certain limits to insure success.

Viscosity Tests

The Engler viscosimeter is used in testing the oil, and the maximum allowable limit is a specific viscosity of 100 at 212 deg. Fahr. It has been found that a very viscous oil will not readily absorb the screenings, nor will it build up a wearing surface of sufficient thickness to protect the concrete base. Also, it is difficult to secure proper penetration with a very viscous oil, even when it is heated to a high temperature and applied under pressure. Another point given special consideration is that the oil must be sufficiently adhesive to securely bind the wearing coat to the concrete base, so that each little piece of rock making up the wearing coat will be held tightly cemented to its neighbor.



THIS APPARATUS MEASURES THE STICKINESS OF OILS

Device for Testing Adhesion

In order to determine directly the stickiness or adhesive property of road oils, and to establish a basis for comparing them, an attempt was made to develop a mechanical device for gaging their adhesive quality. Experiment finally resulted in the apparatus shown in the accompanying illustration, which is known as the Osborne adhesive machine. In principle, the device is a journal "lubricated" with the oil under test and operated by a constant pull of a given weight causing an outer cylinder to revolve. The time required for three complete revolutions of this cylinder is taken as the measure of the adhesiveness of the oil. A constant given temperature is maintained by means of water flowing through a fixed cylinder, or axle.

The fixed cylinder is 2.00 in. in diameter, and the outer cylinder, or collar, 2.01 in. in diameter. The fixed cylinder consists of a hollow drum with an inlet and outlet pipe through which circulating water maintains a temperature of 77 deg. Fahr. The oil to be tested is applied to the outer surface of the fixed cylinder and to the inner surface of the collar, after which the collar is slipped over the fixed cylinder. A cord is attached to the collar and wrapped around it, and a three kilogram weight is attached to the end of the cord. The downward pull of the weight forces the collar to revolve, and the time in seconds required for three complete revolutions is the measurement of the adhesiveness of the oil.

Variations of Quality

An evidence of how much the oils vary in adhesiveness is shown by the results of the road oils tested in which there is a range of 180 to 1700 sec. This wide variation is found in oils all of which fall within the classification of 90 per cent of 80 penetration asphalt. It has been found that there is no uniform ratio of the adhesiveness to the viscosity. For example, of two oils having the same viscosity one was found to be five times as adhesive as the other.

A minimum adhesive test of 300 sec. is required of the road oils to be used on California highways. To give some idea of what this degree of adhesiveness is, it might be said that the balsam compound used on a common type of fly-paper has an adhesive test of about 250 sec.

Assurance of uniformity and relief from delays to construction work due to testing each number of separate carload shipments of oil are secured by buying the oil in large orders of from 3000 to 5000 bbl. at a time and holding it under seal in large tanks to be drawn on as ordered. The road oil plant is carefully inspected as to uniform temperature while the order is being filled, and frequent samples are taken day and night and tested to check the uniformity of the oil.

Upon requisition, oil cars are filled from the tank in the presence of an inspector and are shipped by rail to the contract. From the railroad car the oil is drawn into standard motor truck cars of about 1000-gal. capacity, from which the oil is applied to the road under pressure and at a temperature of about 300 to 350 deg. Fahr.

The standard practice on the California highway system is to apply two coats of $\frac{1}{4}$ gal. per square yard each to the concrete base. Each coat is given all the screenings it will absorb and the first coat is opened to traffic or rolled, according to conditions, before the second is applied. This treatment takes about 100 bbl. of road oil per mile of 15-ft. roadway.

The work of the California Highway Commission is being carried on under the direction of Austin B. Fletcher as highway engineer, and the testing department is under the direction of Clarence B. Osborne, geologist for the commission, who invented and patented the device for adhesive tests.

THE TYPHOID DEATH RATE for Chicago during 1914 approaches those of London and other European cities. The final statistics, just compiled, indicate a death rate of 6.97 per 100,000. The total number of cases verified was 1181, of which 56.4 per cent were hospitalized and 25.4 per cent were cases in which the infection was contracted outside the city. This figure is 5 per cent less than in previous years. Contact cases numbered 83 and in 849 cases there were positive Widals.

Distribution of Vertical Soil Pressures

Tests at Engineering Experiment Station of Pennsylvannia State College Have Been Extended to Embrace Greater Loads and Several Kinds of Soil

By J. A. MOYER
Acting Director, Engineering Experiment Station, Pennsylvania State College

WITH the object in view of developing some practical mathematical formulæ which will be useful to the practical designer of culverts, arches and subways, the investigations of the vertical pressures due to the loading of sand and other soils on such structures, being conducted by the Engineering Experiment Station of Pennsylvania State College, have been continued since the last report was published. (See the Engineering Record of May 30, 1914, page 608.) The results of the tests thus far indicate that the per cent of transmission increases with the increase of load, that for depths of earth greater than 2 ft. this per cent of transmission is always less than twenty, and that for eccentric loads it is always less than twenty when the loading strip is not over any part of the weighing strip.

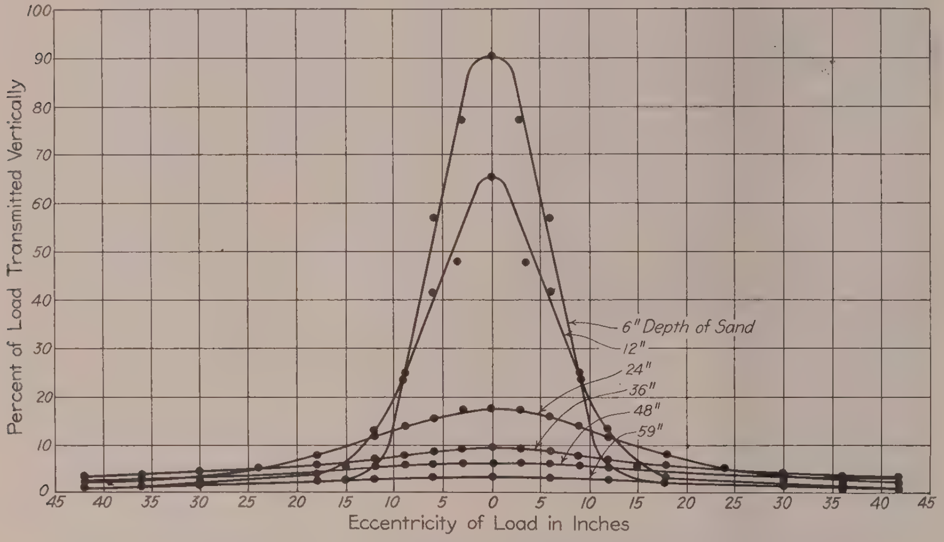


FIG. 1—PER CENT OF LOAD TRANSMITTED FOR DIFFERENT DEPTHS OF SAND
Loads, varying from 1400 to 5500 lb., applied on 12 x 12-in. area; weighing area 12 x 12 in.

The data reported in the previous article related to tests with sand in quantities making only moderate loadings. The present paper deals entirely with results obtained when the loading was carried as high as 6 tons.

The apparatus used is shown in the photograph. It consisted of a large wooden box, 6 x 12 ft. supported on concrete piers by means of I-beams and joists. In the center of the floor of the box there was an opening 12¼ in. square, into which the weighing strip or "block," measuring 12 x 12 in., was placed. The load on this weighing strip was supported on a large Standard platform scales as shown. A "restricting" box, *R* containing the soil tested surrounded the weighing strip. In the tests here recorded the size of this box was 4½ x 9 1/3 x 5 ft. deep, as compared with one 3 x 4 x 4 ft. deep in the previous tests. The loads were applied by a calibrated hydraulic jack, *J*, exerting its load on a wooden strip 12 x 12 x 3½ in., which rested on the surface of the soil. The jack was blocked up so that it acted against an overhead I-beam. The tension rods, *T*, were threaded to permit ready adjustment of the height of the beam above the surface of the soil as required for the various depths.

METHOD OF CONDUCTING TESTS

In conducting these tests a uniform method of procedure was adopted. A piece of canvas was spread lightly over the weighing strip to prevent the soil from running through the ⅛-in. spaces between the weighing strip and the box. The soil was then shoveled in and leveled off at a certain depth. The loading strip was firmly embedded by hand pressure so as to have a good bearing area. The jack was then placed in position and blocked up against the I-beam. A dead-load reading of the platform scale was taken and loads were applied and readings of the scale beam noted for various loads as indicated by the gage up to the capacity of the apparatus, or to a point when the loading block sank into the soil as fast as the load was applied. The difference between the two scale readings—before and after applying the load—gave the amount of pressure transmitted through the soil. One hundred times this difference divided by the known weight of the load determined from the calibration curve gave the percentage of the load transmitted vertically through the soil. The distribution of this transmitted pressure was readily determined by varying the position of the loading strip. To make sure that the loading strip would sink evenly into the soil great care was exercised in preventing the jack from getting out of plumb. Whenever uneven sinking occurred the test was discontinued and run over again. Throughout all the tests the method of applying the load was precisely the same as that employed in calibrating the jack and gage.

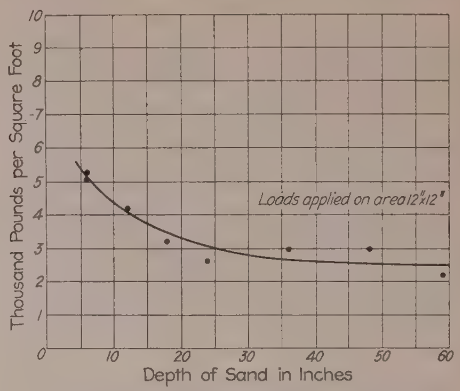
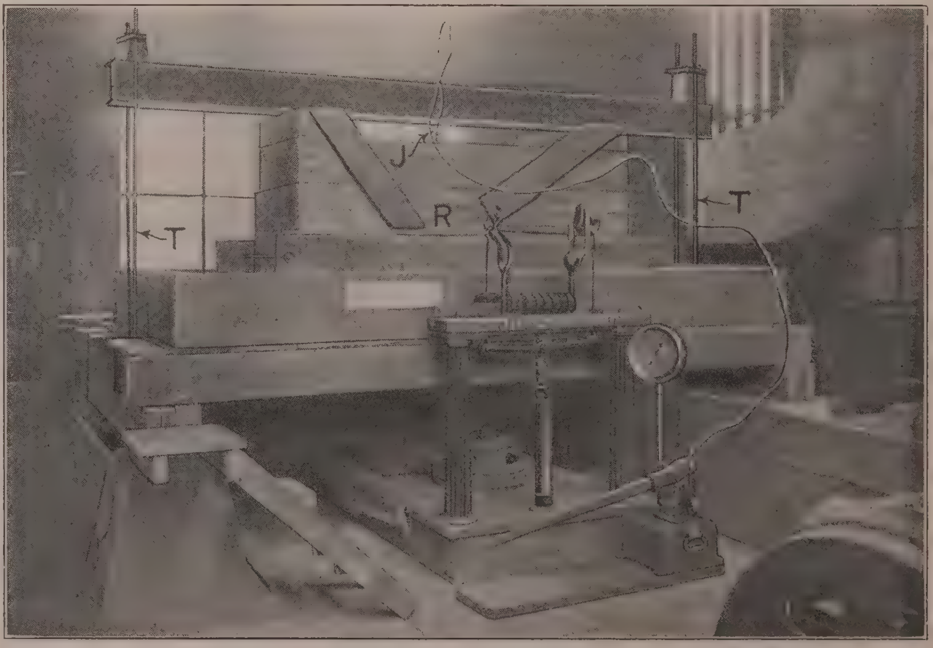


FIG. 2—RELATION BETWEEN MAXIMUM BEARING POWER AND DEPTH OF SAND

SAND TESTS

A series of tests was run on dry sand for the purpose of determining the effect of the size of the "restricting box." The size of the box used for this purpose in the previous tests reported was 3 x 4 x 4 ft. deep. In the present series this size was increased to the larger size above mentioned. Suitable bracing was provided in order to prevent the sides of the box from bulging when large pressures were used.



APPARATUS USED IN MEASURING DISTRIBUTION OF SOIL PRESSURES

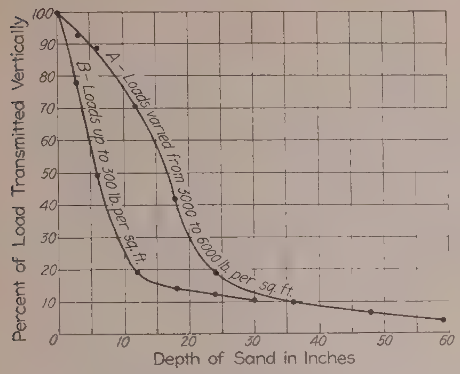


FIG. 3—PER CENT TRANSMISSION IN SAND FOR HIGH AND LOW PRESSURES

The sand used in these experiments was the same as that used in the former experiments, namely, clean, dry river sand, of medium sharpness—a typical brown building sand. The following depths of this sand were tested: 3, 6, 12, 18, 24, 36, 48 and 59 in. For each depth the eccentricity of the load was varied from 0 to 42 in. both right and left. The loads were applied in increments of 1000 lb., as indicated by the gage on the hydraulic jack, up to the point where the loading strip sank into the sand as fast as the load was applied. As determined from the calibration curve these loads varied from about 600 lb. to between 2200 and 6000 lb. according to the depth of the sand.

The curves in Fig. 1 show the distribution of the vertical component of pressure due to a concentrated load. The points plotted are the averages of all the results obtained for a given depth of sand and a given eccentricity of load. On the average about eight observations are represented by each of these points. The calculated percentages of transmission lie for the most part well within 10 per cent of the mean value, as in the previous tests. It will be noted that as before there was a very marked change in the per cent of transmission when the eccentricity of the load was equal to the width of the weighing strip, and at this point the maximum value was 13 per cent. For greater eccentricities this value was never exceeded. By comparing the results of the present tests with those of the previous ones it will be readily seen that the size of the restricting box does not make any appreciable difference.

The maximum bearing power of the sand decreased with the depth of sand, as shown in Fig. 2, the plotted points in the curve being the averages of the maximum loads that could be applied at zero eccentricity. This was possibly due to the fact that the sand had more opportunity to flow at the greater depths. Furthermore there was a distinct tendency for the percentage of transmission to increase as greater loads were applied. The point is well illustrated in Fig. 3. Curve A shows the maximum values for sand obtained by averaging the results for the two highest loads that were applied. These loads averaged from 3000 to 5000 lb. per square foot. Curve B shows the results obtained in previous tests under the same conditions, but with loads up to 300 lb. per square foot only.

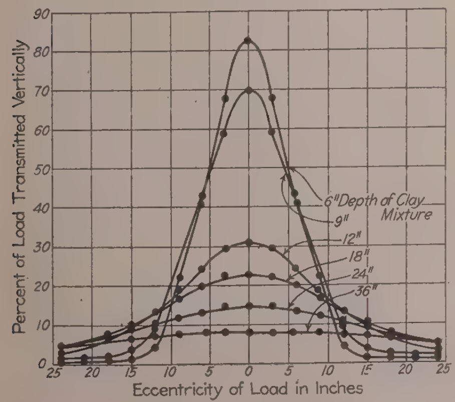


FIG. 4—PER CENT TRANSMISSION FOR CLAY MIXTURE

Loads, varying from 600 to 10,000 lb., applied on 12 x 12-in. area; weighing area 12 x 12 in.

TESTS OF A CLAY MIXTURE

It seemed desirable to investigate a soil having a high degree of tenacity, as opposed to sand, which has practically no tenacity. Accordingly various mixtures of clay, loam and sand were tested for tenacity in the soils laboratory of the School of Agriculture. The mixture which appeared to give maximum tenacity, and which was therefore used, consisted of 85 per cent clay, 10 per cent sand and 5 per cent loam. Technically the soils may be described as follows: (1) Silty yellow clay, containing practically no gravel; (2) gravelly phase of a silty loam, containing 22 per cent gravel and (3) brown river sand (the same as in previous tests).

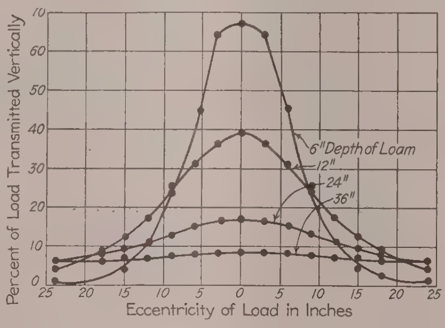


FIG. 5—PER CENT TRANSMISSION FOR LOAM

Loads, varying from 500 to 10,000 lb., applied on 12 x 12-in. area; weighing area 12 x 12 in.

The above material was run through a screen of approximately ¼-in. mesh and spread out on the floor. After being thus room-dried for twenty-four hours the 85-10-5 per cent dry mixture was made up as required. The mixing was done by hand with shovels until a uniform color was obtained. When ready for testing the mixture had just enough moisture to cohere slightly when compressed by hand. Some idea of its tenacity may be gained from the fact that when the heavy loads were applied a brick was formed that could be broken up only by means of a pick. The following are the chief physical characteristics of this mixture:

Moisture	11.3 per cent
Weight per cubic foot, loose	83.0 lb.
Weight per cubic foot, packed	103.5 lb.
Angle of repose	38½ deg.

Meanwhile a new test box for containing the soil under test had been constructed. As the two series of tests on sand indicated that the size of this box did not make any noticeable difference, the new box was made as small as possible, but large enough to obtain the distribution of pressure. It was 6 x 2 x 5 ft. high and was built in two sections, 2 and 3 ft. high for the sake of convenience. The lower section of the box was placed centrally on the floor of the test apparatus and securely fastened.

The mixture was shoveled into the box and leveled off at a depth of 6 in. The method of procedure was exactly the same as in the sand tests except that the eccentricity of the load was varied from 24 in. right to 24 in. left, and back across the soil to the starting point. The first run was therefore on loose soil. The loads were applied as before, but in most cases up to 10,000 lb. per square foot, any further increase being prevented by the capacity of the apparatus. The depth of sinking was recorded for each new increment of load. The depths tested were 6, 9, 12, 18, 24 and 36 in. The application of pressure formed a "brick" underneath the loading strip. This compressed mass was not broken up but was covered by loose soil when it was desired to increase the depth. In all cases enough extra loose material (1½ to 3 in.) was added so that at the end of the test the compressed material was at the depth recorded.

The curves in Fig. 4 show the distribution of vertical pressure for various depths of the clay mixture. It will be noted that they have the same general characteristics as the same curves of Fig. 1. Each plotted point represents on the average thirty-five readings. In practically all cases there was quite a regular increase in the per cents of transmission as the load varied from 600 to 10,000 lb. per square foot, the maximum loads causing an average increase of 36 per cent in the transmission as produced by the minimum loads.

TESTS IN LOAM

The tests in loam were run in exactly the same way as those on the clay mixture, but only on 6, 12, 24 and 36-in. depths. The loam contained enough moisture to cohere slightly by hand pressure and when the loads were applied a very solid brick was formed.

The following are the chief physical characteristics of the loam:

Gravel	22 per cent
Moisture	13.6 per cent
Weight per cubic foot, loose	73 lb.
Weight per cubic foot, packed	94 lb.
Angle of repose	40½ deg.

Fig. 5 shows the distribution curves for the various depths of loam tested. Each point represents on the average forty-three readings. As in the case of clay there was quite a regular increase in the per cent of transmission as the loads varied from 500 to 10,000 lb. per square foot, the average increase from minimum to maximum being 47 per cent.

Referring to the distribution curves of the three soils as shown in Fig. 1, 4 and 5,

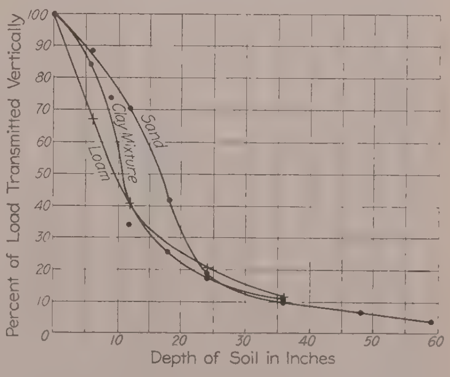


FIG. 6—MAXIMUM PERCENTAGES FOR THREE SOILS

Sand loads varied from 3000 to 6000 lb. per square inch; loam, from 8000 to 10,000; clay mixture, from 7000 to 10,000.

it will be noted that all the soils tested exhibit the same general characteristics, namely, a marked flattening of the curves with an increase in depth of soil, and a rather sudden bend (in the case of small depths) at the point where the loading strip just clears the weighing strip. As was to be expected, this bend is more marked in the sand curves; for sand, on account of its lack of cohesion, has less distributing power than other soils. A study of all these distribution curves reveals the fact that when the loading strip was not over any part of the weighing strip the per cent transmission was always less than twenty.

A comparison of the averages of all the results obtained for the three soils when there was no eccentric load corroborates the original contention that inasmuch as sand gives practically no arching effect it offers the worst conditions for loading and therefore gives the maximum vertical transmission of pressure.

In order to arrive at some definite conclusions in regard to the vertical transmission of pressure due to external loads, it was necessary to plot a series of curves from the maximum values obtained. These maximum values of transmission, as stated before, occurred for the highest values of loads as indicated in Fig. 6. Referring to this figure it will be noted that for depths smaller than 2 ft. sand transmitted the greater pressure, and that at greater depths the three soils (sand, clay mixture and loam) gave practically the same per cents of transmission, which were always less than twenty. As the loads employed were such as are usually met with in practice, the value of these curves will be readily appreciated.

These tests are being conducted in coöperation with the Pennsylvania State Highway Department, under the general supervision of Willis Whited, bridge engineer of that department. Actual charge of the work has been in the hands of R. B. Fehr, instructor in mechanical engineering, and assistants employed by the Engineering Experiment Station. Complete data, curves, and results will be published later in Bulletin 11 by the experiment station.

RAILWAY DEVELOPMENT IN SOUTH CHINA is practically at a standstill on account of the war in Europe, according to a recent consular report. Even the work preliminary to future construction has to a large extent been discontinued, and it is thought unlikely that there will be any further activity until the war is settled, and also, until prospective political troubles in China are cleared away.

Change of Site Does Not Affect Contract

Changing Plans After Annulment of Contract, However, Relieves First Contractor from Liability for Excess Cost of Work

By WILLIAM B. KING

Of King & King, Washington, D. C., Member of the Bar of the Court of Claims

ON JANUARY 4 a decision was made upon the claim of the California Bridge & Construction Company, a contractor, for building a sawmill, boiler house and steel chimney at the navy yard at Mare Island, California. The contract was annulled by the United States for the reason that the contractor refused to proceed with the work, because of an alleged change of site by the United States. The contractor sued the Government for expenses incurred prior to annulment; the Government responded by a counterclaim for the excess of cost over the original bid paid the contractor who subsequently did the work.

The court found that the contract did not provide any fixed site and that the Government was within its rights in locating the site. It was therefore held that the Government had a right to annul the contract on account of the refusal of the claimant to proceed. Judgment was rendered against the contractor on its claim for expenses. But it appeared that the contractor had actually delivered material to the United States which had been only in part paid for. The court allowed the balance of the cost of this material in favor of the claimant.

COUNTERCLAIM NOT ALLOWED

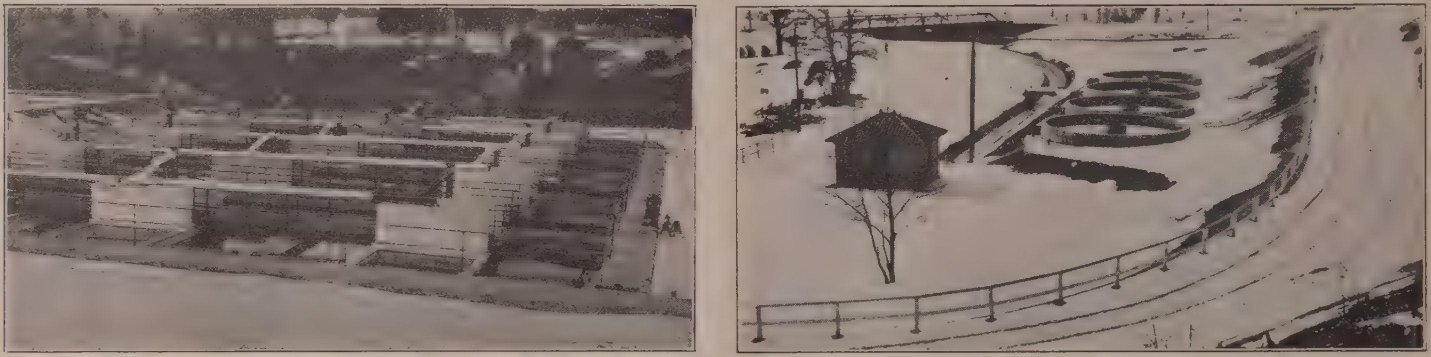
In considering the counterclaim the court found that the buildings subsequently erected differed substantially from those contracted for with the claimant. It was held by the court that under these circumstances there could be no recovery on account of the difference in the ultimate cost and that involved in the original cost. The court said in part:

"When the Government took over the work and let a new contract, its rights and those of the original contractor were fixed by the law applicable to the rights and liabilities then existing. The Government could then sue for a breach of the contract or could have the work done and charge the contractor for the cost in excess of the original contract price. But electing to do the latter the Government must show that the work was done by another contractor under a contract and specifications which did not materially or substantially depart from the old contract and specifications. To allow the Government under the provisions of the original contract or specifications the right to make material changes in the specifications resulting in substantial alterations of the buildings as originally contemplated would be in effect to say that any sort of changes or alterations could be made after the declared breach."

The decision is important in affirmation of the principle that the owner has no right to charge against a defaulting contractor the cost of work performed otherwise than in accordance with the original contract.

Factors in Design of Imhoff Tanks at Fitchburg

THE factors upon which the design of the Imhoff tanks at the new sewage treatment works in Fitchburg, Mass., was based were discussed March 3 in a paper before the sanitary section of the Boston Society of Civil Engineers by David A. Hartwell, chief engineer of the Sewage Disposal Commission of Fitchburg. There are five tanks, rectangular in plan, each measuring 30 x 90 ft., with a bottom in the form of three V-shaped depressions, as described in the ENGINEERING RECORD of June 6, 1913, page 633. The depth of sewage in the tanks is 24 ft. 5 in.



IMHOFF TANKS IN OPERATION AND SECONDARY TANKS WITH EFFLUENT CHANNEL LEADING TO RIVER

POPULATION CONSIDERED

While it is possible to deliver 14,000,000 gal. a day to the disposal works still the plant was not constructed to treat that amount of sewage. The population of Fitchburg in 1910 was 37,826. The average rate of gain for each 5 yr. for the 30 yr. from 1880 to 1910 was 21 per cent, and the average gain for each 5 yr. for the 20 yr. from 1890 to 1910 was 14.6 per cent. With an assumed increase of 15 per cent each 5 yr. the population would be 43,400 the present year, 57,400 in 1925 and 87,200 in 1940. At the present time there are about 35,000 people using the sewers and the flow is about 3,500,000 gal. It was thought best to make provision in designing the Imhoff tanks for a population of 55,000, which would probably be as many people as would be contributing to the sewage flow in 1930 or 1935, owing to a considerable number of the people living at locations without sewerage.

SLUDGE CAPACITY

The sludge digestion compartment of each Imhoff tank was designed to store the sludge for a period of 6 months on the basis of a production of 7 cu. ft. of sludge per day for each 1000 persons.

The sedimentation compartment provides for a settlement period for different flows as follows: For a rate of 3,000,000 gal.

per day, 7.3 hr.; for 4,000,000 gal., 5.5 hr.; for 5,000,000 gal., 4.4 hr.; for 6,000,000 gal., 3.7 hr.; for 7,000,000 gal., 3.2 hr.; for 10,000,000 gal., 2.2 hr.; and for 14,000,000 gals., the capacity of the present siphon line which feeds the plant, 1.6 hr. The velocity of flow through the tank would be 16.3 ft. per hour with a rate of 4,000,000 gal.; 20.4 ft. per hour with 5,000,000 gal.; 24.5 ft. per hour with 6,000,000 gal., 32.7 ft. per hour with 8,000,000 gal.; and 57 ft. per hour with 14,000,000 gal.

Concrete Blocks Cover Sewage Filter Underdrains

Type of Floor at Fitchburg Plant Provides Open Area of 43 Per Cent for Drainage and Ventilation of Bed 10 Feet Thick

MOLDED concrete blocks spanning channels in the floor are the feature of the underdrainage system in the 2.14 acres of sprinkling filters at the new sewage treatment works in Fitchburg, Mass. The depth of stone in the filters ranges from 10 to 10½ ft. As described in a paper presented before the sanitary section of the Boston Society of Civil Engineers March 3 by David A. Hartwell, chief engineer of the Fitchburg Sewage Disposal Commission, the filter floor is constructed of cement concrete with Clinton wire reinforcement. The floor drainage consists of troughs or channels spaced 15 in. on centers and having clear spans of 11 in. and a depth of 3 in. The depth of concrete in the floor below the trough is 3 in. Over these troughs were placed blocks made of cement and stone dust to keep the broken stone from falling into the troughs. The stone dust was a by-product from the crusher and was used in preference to sand, which was also abundant at the works.

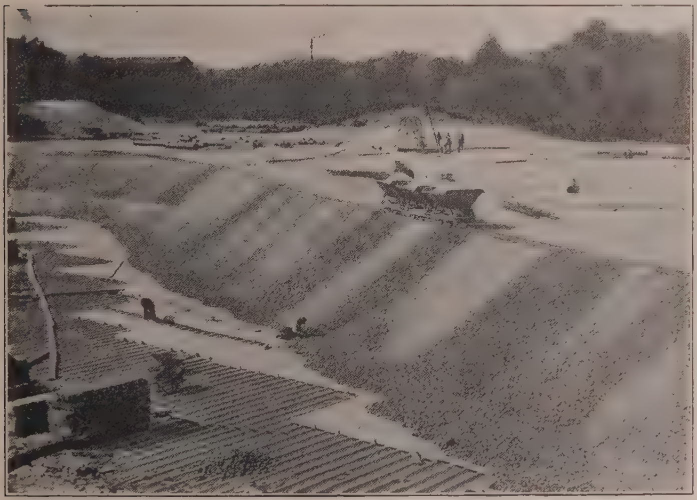
These blocks were made of 1 part cement to 2 parts stone dust. They were 17 x 4 x 1⅛ in. in dimensions and as placed in the floor the top surface measured 17 in. x 1⅛ in. This form of floor construction provides a type having 43 per cent of opening for drainage or ventilation. The blocks were cured about 36 hr. in moist air and three weeks in water. In actual service each block sustains a total load of less than 250 lb. Tests were made of about two blocks in every thousand, and they would break with a center load of 350 to 600 lb. with occasionally a load as high as 1000 lb. In all about 360,000 blocks were used.

The floor of the filter is divided by an inspection or flushing gallery 410 ft. long into two equal areas. Each trough or channel in the filter floor has a port-hole or outlet into this gallery about 2 ft. 5 in. above the gallery floor. The troughs or channels have a slope of 6 in. from the flushing gallery to the collecting drains at the sides of the filter, the length being about 106 ft. A 6-in. water main, with pressure about 110 lb., is laid in the gallery to provide water for flushing purposes.

Placing Broken Stone

The broken stone in the filter is from 10 to 10 ft. 6 in. in depth and the size was specified to pass through a screen having holes 2 in. in diameter and be retained on a screen having holes 1 in. in diameter. About two-thirds of the stone used was local granite and one-third was granite and trap rock brought to the city by railroad. The quarry where the local granite was obtained is located 3 mi. from the filter and the broken granite was hauled in four Alco trucks. The stone was screened at the filter as well as at the crusher. During 1913 the stone was deposited in the filter by running trucks and carts directly onto the bed with plank protection but this method was changed and all stone placed in 1914 was by track and construction dump car.

The Fitchburg plant, which was described in the Engineering Record of June 7, 1913, page 633, was designed by Harrison P. Eddy of Metcalf & Eddy, consulting engineers, of Boston.



MOLDED CONCRETE BLOCKS SPANNING CHANNELS IN FLOOR SUPPORT A 10-FT. BED OF CRUSHED STONE AT FITCHBURG FILTERS

AFTER TWO SUCCESSIVE MORNINGS WITH TEMPERATURE AT MINUS 8 DEG. FAHR. THE FILTER SURFACE WAS NOT FROZEN

Paving by Day Labor Receives Trial in Duluth

PAVING by day labor in Duluth during the past season was found to cost on the average 20 cents per square yard less than that of similar work let by contract during the same period. According to John Wilson, city engineer, the success of the day-labor policy will no doubt mean the continuation of that method. Mr. Wilson states, however, that while he believes it is possible to secure more satisfactory work by day labor, he is somewhat in doubt as to whether, in the long run, work can be done much cheaper by day labor than if let in large contracts, thus inviting the bids from contractors with first-class outfits. The idea sometimes expressed that on paving put in with day labor the cost of inspection can be eliminated, is also tabooed by Mr. Wilson, who considers an inspector quite as valuable on city work as on that of a contractor.

Cost of Work

The most important piece of work to be carried out on the day-labor plan comprised 54,367 sq. yd. of brick and sandstone paving on West Superior Street, the total cost of which, including grading, sewer work and resetting curb, was $128,139. The work was authorized by four separate orders of the city council. The first order consisted of repaving an old tar macadam street from Fifteenth to Twenty-fifth Avenues. The grade of the 56-ft. street was raised about 2 in. by reducing the height of the old curb on the lower side from 8 to 6 in. and on the upper side from 10 to 8 in., thus allowing part of the old macadam foundation to remain. The new pavement consisted of a 5-in. 1:3:6 concrete base, a 1½-in. sand cushion and vitrified paving block. The distribution of cost was as follows: Grading, $6505.95; paving, $61,126.64; resetting curb, $619.99, and sewer work, $406.43. The paving, exclusive of grading, cost $2.055 per square yard. The unit prices of material, delivered f. o. b. Duluth, were as follows: Brick per square yard, street measurement, $1.10; sandstone, $1.65; cement, $1.93 per barrel, less 40 cents for return of sack; gravel, $1.10 per cubic yard; concrete sand, 80 cents per cubic yard, and cushion sand, 60 cents per cubic yard. Labor was obtained at 22.5 cents per hour for a 10-hr. day and teams were also obtained for 55 cents per hour per 10-hr. day.

The second order was for a continuation to the west of five blocks more, replacing an old cedar-block pavement, all visible evidence of its presence having disappeared some years ago. The cost per square yard averaged $2.06. The third order consisted of about 521 sq. yd. on Garfield Avenue and averaged $2.11 per square yard. The fourth order extended the work of the first order three blocks farther east. Due to the grade and also because the pavement from Twelfth Avenue easterly was of sandstone, that material was used from Twelfth to Fourteenth Avenues, and brick from Fourteenth to Fifteenth Avenues.

The sandstone comprised in all 6039 sq. yd. and the brick 2153 sq. yd. The cost per square yard of the former was $2.86, while that of the brick was $2.15. Some of the additional cost of the sandstone was due to the difficulty in maintaining traffic and also to bad weather conditions.

The sandstone pavement consists of a 5-in. concrete base, 2-in. sand cushion and sandstone block from 10 to 16 in. in length, from 4 to 6 in. in width and from 6 to 7 in. in depth. Sand filler was washed into the joints until about one-half full and the remaining space filled with 1:2 grout.

Before laying the brick the sand cushion was rolled and the grouting prepared and applied according to the National Paving Brick Manufacturers' specifications.

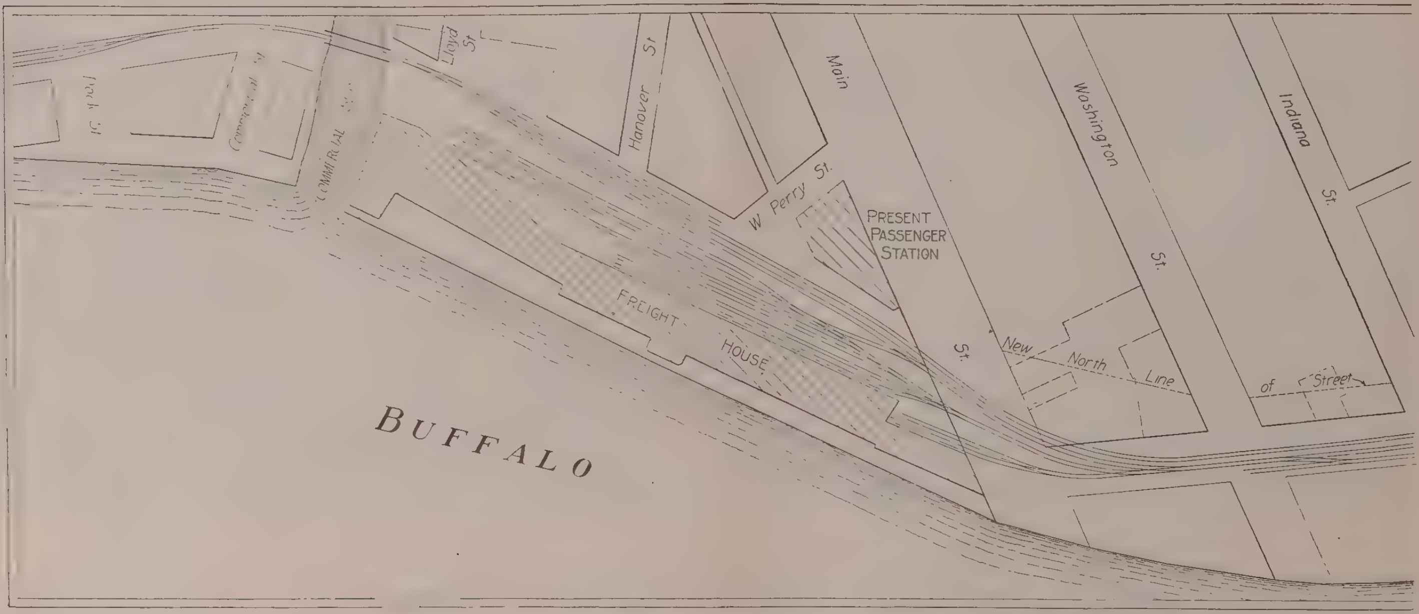
Mr. Wilson states that it was difficult to get the foreman to realize the importance of quickly following the first course of grout with the second, and keeping it thoroughly wet until hardening had taken place. He also found that there was a tendency to rush this part of the work and keep far too close to the roller.

Lackawanna Passenger Terminal at Buffalo

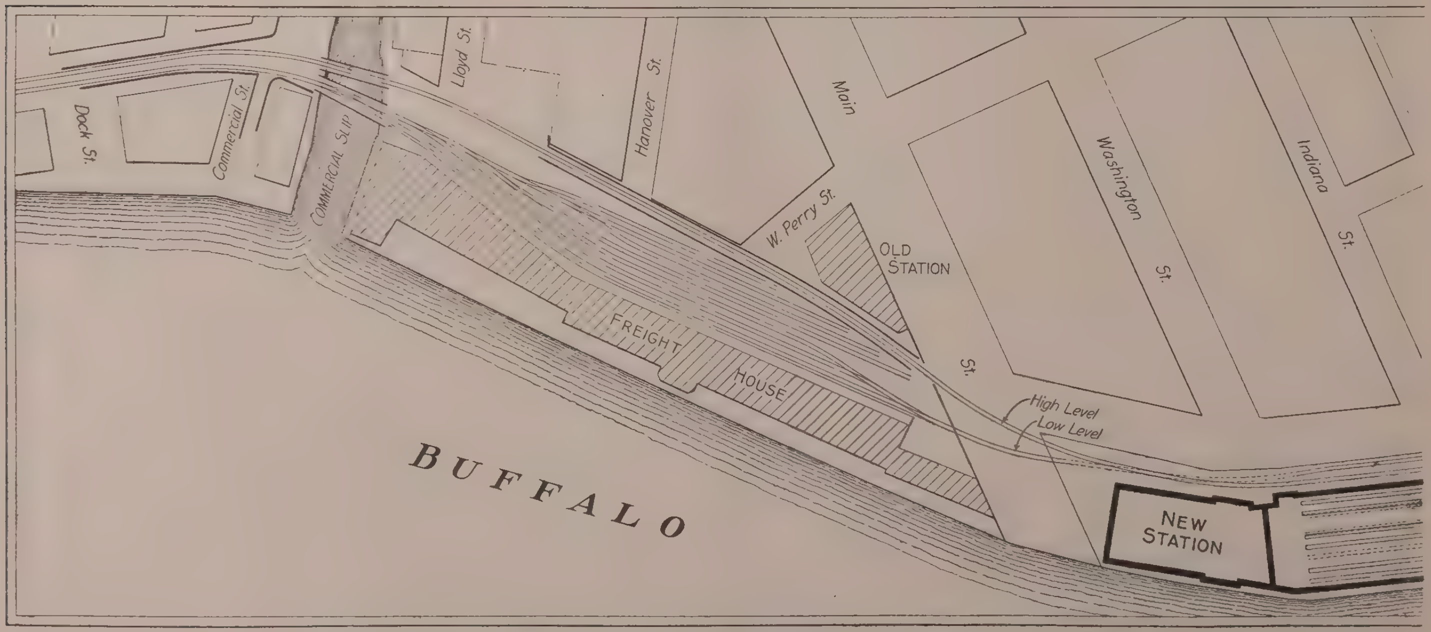
New Station Will Occupy Different Site and Will Be Double-Decked, Upper Level Being Carried on Reinforced-Concrete Structure

REPLACEMENT of the Buffalo passenger terminal of the Delaware, Lackawanna & Western Railroad at the foot of Main Street, outgrown by the company, by a commodious terminal on the opposite side of the street is under way. The new station will be a double-deck structure, the six station tracks and Bush trainshed on the upper level being carried on reinforced-concrete columns, and the lower level being given over to baggage and express. The station building will be on the east side of Main Street, south of Ohio Street. One track on each level will lead past the station to the freight house and coal docks west of Main Street. To provide sufficient width for the layout Ohio Street has been moved northward for a length of three blocks, and several streets have been abandoned.

Comparison of the old and new layouts is afforded by the illustrations. The present station occupies a triangular piece of land on the west side of Main Street. It is served by two tracks only, which reach it with the aid of a very sharp curve between Washington and Main Streets. Directly opposite the old station, fronting on the Buffalo River, is the Lake freight house for Great Lakes traffic, served by five tracks. To the westward, at the mouth of the river, are the company's coal docks, which are reached by the freight track past the station. The present tracks are in the streets at grade and the entire layout is badly cramped, although its advantageous position along the waterfront has caused the company to decline to join with the other railroads entering Buffalo in a union station at a site more convenient to the other railroads.



MAP OF THE OLD DELAWARE, LACKAWANNA & WESTERN LAYOUT AT BUFFALO—PRESENT PASSENGER



NEW LAYOUT—NEW STATION AND TRAINSHED IN WIDENED SPACE EAST OF MAIN STREET—TWO LEVELS

Lack of space has heretofore been an obstacle in the way of an adequate terminal. It is apparent that the sharp turn east of Main Street rendered the present site unsuitable, even if a sufficient area could be obtained. East of Main Street the strip between Ohio Street and the river occupied by docks, warehouses and a city fireboat slip, was too narrow to meet the needs. By acquiring the property on the north side of the street, however, and moving the street northerly—10 ft. at Illinois Street, 40 ft. between Indiana and Washington Streets and 120 ft. at Main Street—the desired width was obtained.

EXTENT OF IMPROVEMENT

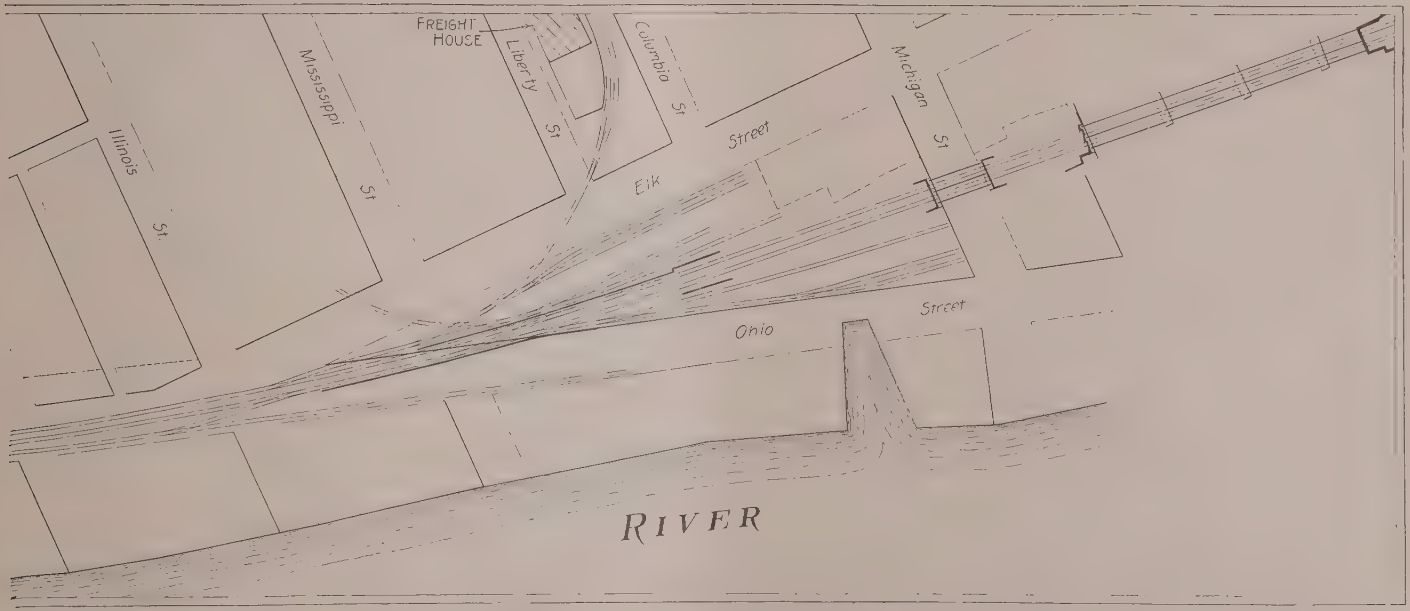
The improvement begins just east of Michigan Street, at which point the new tracks swing to the south. At this same point the present tracks, which are elevated to pass over the Ohio Street yard of the New York Central Railroad, drop on a 1.87-per cent grade to the level of Ohio Street. The two new main tracks will continue on the high level and at Columbia Street will begin the spread to the six trainshed tracks, which will terminate at Washington Street. A seventh track of the high level will pass the trainshed and station building and continue on a viaduct across Main Street to a connection with the coal docks and also a back-up connection with the freight house.

The upper-level tracks and the trainshed will be carried on a reinforced-concrete deck and concrete columns similar to those of the Soo line freight terminal in Chicago, described in this journal Aug. 16, 1913, page 188. This leaves the space on the ground level available for baggage, express and warehouse purposes. A switchback arrangement makes it possible to reach this space with tracks. At Michigan Street a track leads out of the westbound main and descends on the north side on a 2.69-per cent grade to the lower level, which it reaches at Illinois Street. At this point it switches back under the upper yard, whence connection is made with the three tracks to be installed ultimately on the lower level under the trainshed.

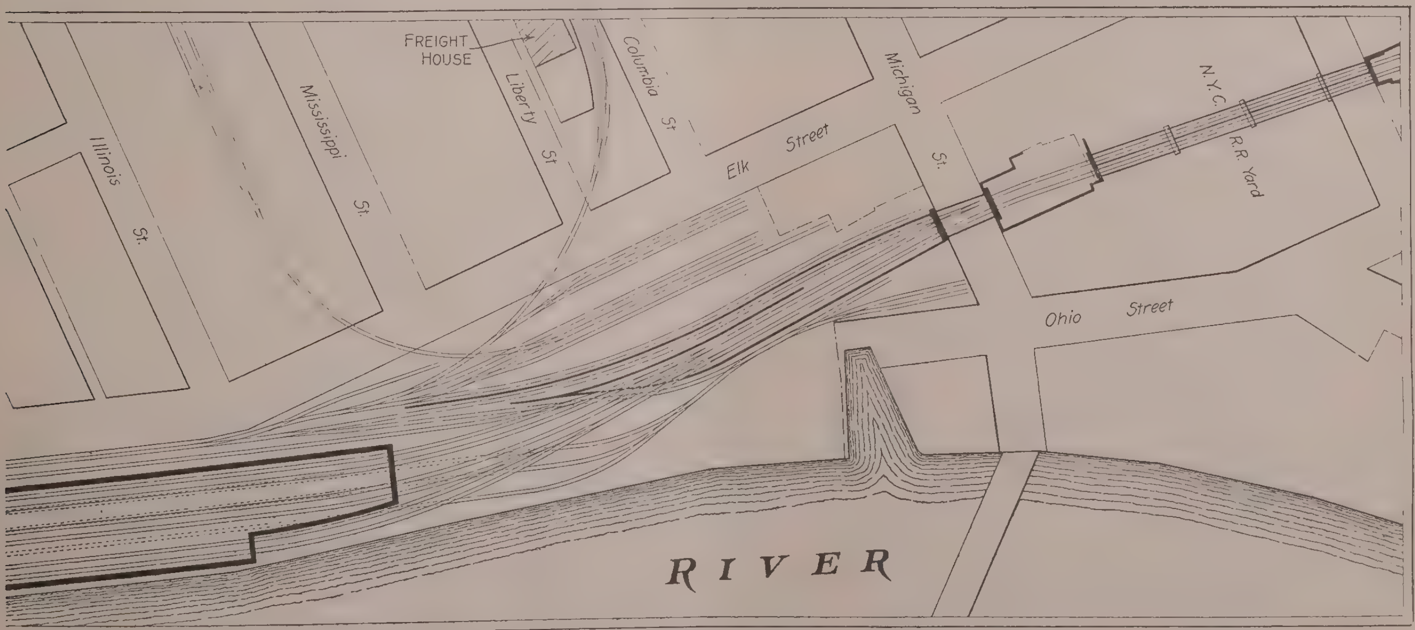
The ramp connection on the north side continues on the street level along the south side of Ohio Street, passes under the single-track viaduct opposite the station building, crosses Main Street at grade and affords a connection with the freight-house tracks. This connection will be used for emergency purposes only, the high-level connection being used ordinarily.

TRACKAGE

The track details are not complex. As the railroad has no suburban traffic and does not expect to develop any, on account of the competition offered by electric lines, six station tracks are deemed ample to care for all business. A double crossover west of Michigan Street connects each of the six with each of the main tracks. Slight readjustments are required in the connections to the Liberty Street freight house and the industries between Mississippi and Illinois Streets, and to reach the latter a switchback movement will be required. Several team tracks at Ohio and Michigan Streets will be replaced by others along Elk Street opposite Columbia Street. Ohio Street will



STATION ON WEST SIDE OF MAIN STREET—NEW NORTH LINE OF OHIO STREET SHOWN IN DOTTED LINES



OF TRACKS, PASSENGER TRACKS ON UPPER LEVEL, SERVICE AND FREIGHT TRACKS ON LOWER LEVEL be closed from the new location of the fireboat slip to the junction with Elk Street at Illinois Street. West of Main Street no special difficulties are encountered. The high-level track is crowded somewhat north of the existing tracks to allow enlargement of the freight-house layout. The transition from the high to the low level at that point is taken care of by short, heavy grades.

GROUND STRATA

The ground level on the site of the new terminal before excavation was started was from 4 to 8 ft. above mean low water in the Buffalo River. Borings taken at each block show solid rock to be from 31 to 53 ft. below the surface, and overlain with from 10 to 31 ft. of quicksand, on top of which are varying layers of clay, sand, gravel and made ground. The entire structure will be carried on wood piles driven to bedrock. Along the water front a mass retaining wall is to be carried on a heavy timber platform below mean low water. The type of construction is similar to that used in the solid-fill portion of the company's pier 9 at Hoboken, N. J., but the wall is much heavier to take care of the additional weight of the double-deck structure, trainshed and trains.

The Buffalo Dredging Company has the contract for the substructure. The Hedden Construction Company, of New York City, will build the station building, of which K. M. Murchison, of New York, is the architect. The work is being done under the general direction of G. J. Ray, chief engineer of the Delaware, Lackawanna & Western Railroad. A. E. Deal, bridge engineer, has charge of the design. G. E. Boyd, division engineer at Buffalo, is in immediate charge of the construction work.

Progress of Federal Evaluation

SINCE the last review by Thomas W. Hulme, general secretary of the Presidents' Conference Committee, of the developments of the Federal valuation work (see the Engineering Record of Jan. 9, page 40) Order 10, extending the time for complying with Order 2 relating to abandoned property, has been issued by the Interstate Commerce Commission. Eleven railroads have been notified that they will be valued, in whole or in part, as of specified dates. These roads are the Ann Arbor; Atchison, Topeka & Santa Fé (Grand Canyon Line in Arizona); Cincinnati, Hamilton & Dayton; Georgia, Southern & Florida; Maine Central; Nashville, Chattanooga & St. Louis; New York, New Haven & Hartford; Pennsylvania (lines south of Philadelphia, lines in New Jersey and Northern Central lines); St. Louis Southwestern; Savannah & Northwestern, and Southern.

The commission, states Mr. Hulme in his latest report, has under consideration the issuance of orders requiring the carriers to report (a) certain classes of leases; (b) a vast amount of detail information as to prices of labor and material; (c) information in connection with land grants, aids, donations and concessions as required by the fifth section of the Valuation Act; (d) a schedule of industrial side tracks; (e) an inventory of records such as minute books, treasurers' books, account books, etc., and (f) the preparation of inventories by the carriers when so directed.

A general valuation conference, as noted elsewhere in these columns, will begin March 22 at Washington.

Dry Rot in Factory Timbers

Proposed Forms of Construction and Specifications for Timber with High Natural Resistance to Fungus

THE inspection department of the Associated Factory Mutual Fire Insurance Companies has just issued a valuable 100-page pamphlet on the subject of dry rot in timber. F. J. Hoxie (engineer and special inspector for the companies), who prepared the pamphlet, has made extensive studies of the subject for some years. He finds that antiseptic treatment is fully justified, that certain definite specifications for density and durability are necessary, and outlines the emergency treatment of a building suspected of dry-rot infection. The following is a summary of the pamphlet, quoted practically in full:

ANTISEPTIC TREATMENT IS WORTH COST

In building a paper mill or weaving mill in which the atmospheric humidity will be high, antiseptic treatment is well worth its cost with any timbers now practicably obtainable. A creosote treatment of about twelve pounds per cubic foot is as good as anything in practical use for moist locations where the fire hazard is negligible and the lumber is to be near or in contact with the earth, but concrete is generally preferable to timber in such locations.

A form of construction for one-story and basement paper mills and weave sheds which has many advantages, is a concrete floor, protected steel columns, and a heavy plank roof. When a concrete roof is used with high inside humidities in a cold climate, it is necessary to provide efficient insulating material on the outside to prevent it from rapidly conducting away the heat and causing a condensation. A dripping roof is highly objectionable for most occupancies. A thick wooden roof is the best heat insulator that can be had for the price. There are conditions under which it will be worth while to increase the thickness of the roof to four or five inches, with this end in view. In such cases, however, it will be absolutely necessary to use material that is thoroughly fungus proofed with suitable antiseptics. The roof should also be made sufficiently tight to prevent moisture laden air from passing through cracks against the cold outer covering where the condensed moisture will keep the planks water-soaked.

TREATING ROOF PLANKS

Thin plank roofs have been used in a few cases with fibrous insulating material on top that can absorb water. The highly humidified air inside passed through cracks in the roof boards and saturated the insulating material with water, thereby destroying its insulating power and increasing the tendency to rot in the roof planks.

For roof planks, treatment with corrosive sublimate is undoubtedly worth its small cost. No experimental data are available as to the increased life to be expected from this treatment, but judging from experience with other uses to which kyanized material has been put, the life should be greatly lengthened.

For use on a roof where insulation is the first consideration, the planks being made extra thick to secure this end, low-grade material can be used if it is sufficiently resistant to rot; knots, shakes or resin pockets would be of little importance if the material is thoroughly rot-proofed.

In ordinary dry mills, where the average humidity is 50 per cent, or less, it may be possible to obtain Southern pine with sufficient natural resistance to withstand fungus untreated if sufficient care is given to its selection. According to present usage the words "longleaf" and "shortleaf" in connection with Southern pine lumber are meaningless. Heartwood in all varieties is necessary for durability.

SUGGESTED SPECIFICATIONS

The following suggestions for a specification are offered for use when Southern pine timber of an excellent quality is required. The first two paragraphs are from the Georgia-Florida Sawmill Association's specifications:

"For timbers and dimensions there must show on the cross-section between the third and fourth inch measured radially from the heart center or pith, not less than six annual rings of growth, a greater number of which shall show at least one-third summer wood, which is the dark portion of the rings of growth. Wide ringed material excluded by this rule will be acceptable, providing that in the greater number of the annual rings the dark ring is hard and in width equal to or greater than the adjacent light colored ring. In all cases there must be sharp contrast in color between the spring and the summer wood.

"For sizes where the center cannot be determined, the following will apply: There must show on the cross-section an average of not less than six annual rings of growth, with not less than one-third summer wood, and otherwise as provided for in paragraph 1."

Density.—No part of the material shall have a density of less than 30 lbs. per cubic foot when tested by boring 1-in. holes in the ends of the stick, drying and weighing the borings and computing the density from the volume of the hole.

Durability.—Heartwood shall show in all four faces of every stick and sap wood shall not extend more than 2 in. from the corner at any place measured perpendicularly to the corner along the face.

"None of the heart wood shall show less than 4 per cent of rosin when borings are taken with a 1-in. bit, dried and extracted with benzole, the extracted rosin evaporated until it is not soft or sticky when touched with the finger at 70 deg. Fahr.

"A further requirement which will be useful in many cases is that the material shall be branded with the name and location of the saw mill from which it comes."

MIXING GOOD AND POOR TIMBER

The above specifications will require selected longleaf pine from the butts of trees and will undoubtedly command a considerably higher price than "commercial longleaf pine." It will also be worth a higher price. It is a grade not known to the lumber trade at present. There is some of it in the South, but by methods now in use it is mixed with poorer timber and its good qualities are lost, as it is not the average, but the poorest that characterizes the lot.

The place of shipment is no guarantee of the quality of the stock, as in most places where longleaf pine is growing there is also shortleaf and loblolly.

In some places the proportion of longleaf is greater than in others. The care and good reputation of the lumber manufacturer is of more importance in assuring good material than the place of shipment.

Spruce and hemlock are undoubtedly much less resistant to common timber destroying fungi than good quality Southern pine heartwood, and it is a safe rule to avoid the use of these woods without antiseptic treatment in any except the dryest locations.

LIVING FUNGI IN NEW LUMBER

New lumber frequently contains living fungi in a latent form which is difficult to detect. This difficulty is increased by the common practice at many lumber yards of planing the stock just before it is delivered. The only outward manifestation of fungus in the wood is frequently an inconspicuous brownish tinge. Nearly every lumber pile on careful examination will show a considerable proportion of fungus-infected sticks. In some cases infection is from tree fungi that are already dead and harmless. Living plants often start growing in the lumber pile, particularly if the weather is damp, showing lacelike growths between the sticks when the pile is taken down. Lumber showing such growths had best be given an antiseptic treatment if the conditions under which it is to be used are at all moist.

In several cases serious rotting has been caused by timber which was water-soaked by being left uncovered during a long season of rainy weather, being covered in without provision being made for drying. When it is necessary to use such water-soaked timber it will be well worth while to hasten the drying as much as possible by use of the heating system.

Kyanizing can be conveniently done on the job by constructing a tank of concrete or plank of such shape that the material can be packed into it with the least possible voids. It should be weighted or held down with bolts so that it cannot float when the solution is added. This should consist of corrosive sublimate dissolved in water, one pound to twelve gallons of water. The lumber should soak in this solution for a week, the absorption will vary according to the quality and variety of the lumber from 2 or 3 per cent to 40 per cent. Care must be used in handling the corrosive sublimate, as it is intensely poisonous if taken internally.

TREATMENT FOR EMERGENCY

When there is any suspicion of dry rot infection in a building, heating from time to time to 115 deg. Fahr., for a day or two by use of the steam heating coils is well worth the small cost in arresting the progress of a *lachrymans* or *Conidiophoria* infection. In a new building it is particularly useful as it not only arrests these fungi by the action of the heat, but assists in drying the timber, and thereby killing other fungi.

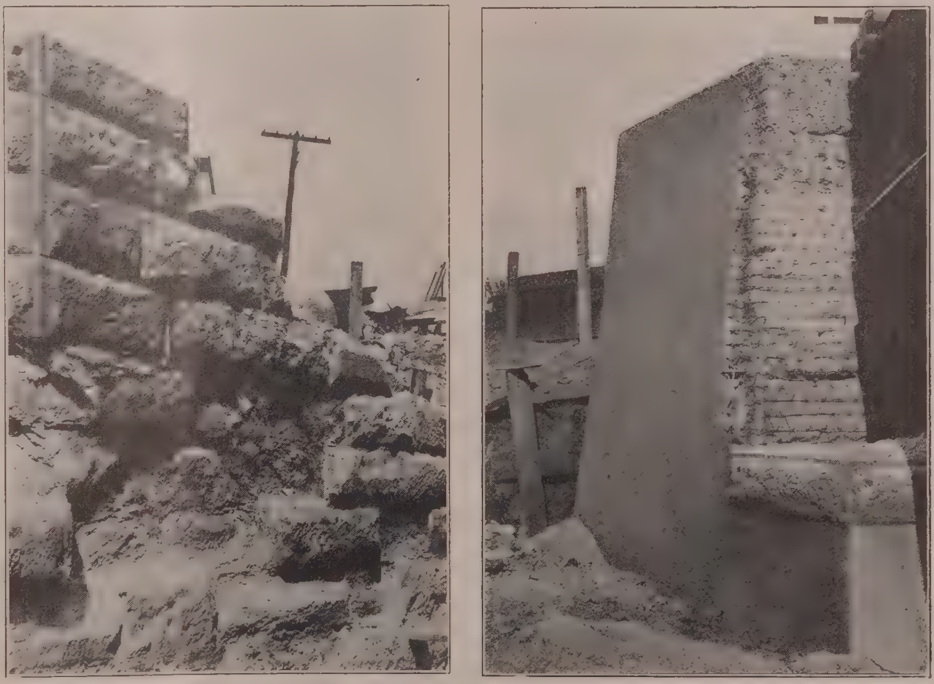
Drying a moist basement will arrest many of the common fungi that require about 100 per cent atmospheric saturation. This can sometimes be accomplished better by a combination of heat and ventilation than by ventilation alone, as the heat reduces the percentage saturation where there is no water supply to keep it up by further evaporation. It is frequently difficult to get a circulation of air in a large basement without fans or other mechanical means. In some cases air has been taken from a basement, which was giving trouble by rotting, for humidifying the mill, thus getting a return for the power required for driving the fan.

One pound of corrosive sublimate dissolved in twelve gallons of wood alcohol has been used several times for local or surface infections with fungus. In come cases this material has been injected into small holes bored in large beams, and in others it has been applied to the surface with whitewash brushes.

Coating Disintegrated Stone Abutments with Concrete

Repair Work Under Traffic of Bridge of Chicago & Western Indiana Railroad Over Chicago Drainage Canal

REPAIR of the rapidly disintegrating masonry abutments of the Chicago & Western Indiana Railroad's four-track swing bridge at its crossing with the Chicago Drainage Canal has recently been completed without interrupting traffic and at a much lower cost than would have been incurred in replacing the abutments. The abutments were built about 1900 and consisted of rough ashlar masonry on a concrete foundation. Although the masonry was built with great care, within a few years after completion signs of disintegration appeared, due largely, it is thought, to the action of frost on the porous masonry, which was originally laid up in cold weather with stone insufficiently seasoned. During the last few years the disintegration increased, until in the spring of 1914 the outside appearance made repair work of some kind imperative. The problem of replacing the piers was a difficult one for the reason that the bridge carries the main traffic of the Chicago belt lines and trains are crossing at exceedingly frequent intervals.



BEFORE AND DURING PROCESS OF COATING WEATHERED ABUTMENT

The appearance of one of the piers before it was repaired is shown in one of the accompanying photographs. In some places the stone blocks were disintegrated to a depth of 16 in., while in other places from 2 to 4 in. only were loose. The wing walls seemed to have suffered the most, some of the blocks being entirely destroyed.

HOW THE REPAIRING WAS DONE

First of all the stone work was thoroughly cleaned. All loose material was carefully removed. Every block was pick-hammer dressed to the hard and solid core; the entire surface was then cleaned with an airblast to remove any dust, and the stone saturated by a stream of water.

At this stage of the work the piers presented an extremely irregular surface, due to the different depths of disintegration of the blocks. The next part of the work consisted in filling the cavities to an even surface line. Owing to the large amount of material required in most places, several applications of a 1:3 cement-gun mixture were necessary. Then the wall surfaces were covered with a single layer of American Steel & Wire Company's No. 26 triangular reinforcing mesh. The mesh was evenly stretched over the stonework and fastened with ½-in. square steel spikes driven into the mortar joints from 18 to 24 in. apart. Over and incasing this reinforcing mesh 2 in. of the 1:3 mix were applied as a final coating.

No repair work was necessary to the copings, which were in good order except that the joints needed cleaning and repointing. The backfill behind the piers was removed by the railroad company and the rear side of the stonework was thoroughly cleaned and given a 1-in. 1:3 coat. A strip about 5 ft. wide adjoining the piers was filled with crushed slag in order to provide for proper drainage. The coating, due to its method of application, is asserted to be water-proof.

TIME CONSUMED

About twenty working days were consumed for the entire job, although on account of numerous interruptions as the result of bad weather conditions the work of construction, which was started Sept. 14, 1914, was not completed until Oct. 22. The working crew consisted of from fifteen to eighteen men. About 290 bbl. of cement and 140 cu. yd. of torpedo sand were used.

The Cement-Gun Construction Company, of Chicago, furnished all materials, labor and equipment for the contract price of $2800. Excavating, shoring and backfilling behind the piers were financed by the railroad. Reduced to unit prices the 1:2:4 concrete used in bringing the wing walls to their proper height averaged $9 per cubic yard; the front surface, including supplying and placing reinforcement, removing old surface, filling cavities and placing a 2-in. final coating, averaged 46 cents per square foot, and the 1-in. coating on the back piers averaged 10 cents per square foot.

Liquid Chlorine Reduces Costs at Bubbly Creek Filters

C. A. Jennings Details His Experience, Giving Seven Operating Features in Comparison with Hypochlorite

ONE of the first filter plants to adopt hypochlorite to disinfect water has recently put in a liquid chlorine outfit. After a month's experience C. A. Jennings, superintendent, in a paper presented recently to the Illinois Section of the American Waterworks Association, draws the following conclusions:

1. There is considerably less labor involved.
2. The absorption of the gas by the water is more rapid.
3. There is no loss of chlorine and smaller quantities can be used to accomplish equivalent results.
4. There is no deterioration of the chlorine in the cylinders while in use or while stored.
5. The changing of the rate of application is easily, quickly and accurately accomplished.
6. There is no odor of chlorine about the plant.
7. The cost is considerably less.

There are mechanical features about the Bubbly Creek filter plant which are peculiar to it. These features are the enormous amount of hypochlorite necessary to disinfect the water; the poor mechanical means for getting into solution all of the hypochlorite used, which have resulted in a large loss of available chlorine and the last pertinent features, the irregularity in the operation of the plant due to a varying consumption and small storage capacity. This often made it necessary to run one or two filters for a time and then suddenly increase the number to eight. Naturally the coagulant and germicide must be proportioned to the amount of water being filtered. Now, while using liquid chlorine, the regulation of the germicide is much more simple, accurate and economical than with hypochlorite.

The ratio of costs during one month's operation with liquid chlorine with an average raw water supply and the treated filtered water as low in bacteria as when using bleach was 1 to 3 in favor of liquid chlorine. It is hardly probable that every plant will show such a large difference in the costs of disinfection by the two methods.

Cement for Highways purchased by the California State Highway Commission totaled 132,955 bbl. in 1912, 190,622 bbl. in 1913 and 572,066 bbl. in 1914.

Literature

For the Civil Engineer and Contractor

New Publications

Preventing Losses in Factory Power Plants. By David Moffat Myers. Cloth, 5½ x 7½ in.; 560 pages. New York, the Engineering Magazine Company. $3.

Engineering Office System and Methods. By John P. Davies, M.E., Assoc. Mem. Am. Soc. C.E. Cloth, 6 x 9 in.; 544 pages. New York and London, McGraw-Hill Book Company, Inc. $5 net.

The Art of Estimating the Cost of Work. By Wm. B. Ferguson, Naval Constructor, U. S. Navy. Estimating costs, especially repair work in jobbing shops. Cloth, 5 x 8 in.; 97 pages. New York, the Engineering Magazine Company. $1.

Descriptive Geometry.—For students in engineering science and architecture. By Henry F. Armstrong, Associate Professor of Descriptive Geometry and Drawing, McGill University. Cloth, 7 x 10 in.; 121 pages. New York, John Wiley & Sons, Inc., $2 net.

The Truth About the Conservancy Law of Ohio. Report of the Miami Valley Flood Prevention Committee, O. B. Brown, Secretary. Paper, 6 x 9 in.; 45 pages.

An explanation of the law and the effect thereon of proposed amendments.

The Flow Over Weirs with Imperfect Contractions. By G. J. Davis, Jr., Dean of College of Engineering, University of Alabama, formerly Assistant Professor of Hydraulic Engineering, University of Wisconsin. Bulletin 699, University of Wisconsin. Paper, 6 x 9 in.; 73 pages.

Plain and Reinforced-Concrete Arches. By J. Melan, Professor of Bridge Design at the German Technical School at Prague. Authorized translation by D. B. Steinman, C.E., Ph.D., Professor of Civil Engineering, University of Idaho. Cloth, 6 x 9 in.; 153 pages. New York, John Wiley & Sons, Inc. $2 net.

Investigation of Flow through Four-Inch Submerged Orifices and Tubes. By L. R. Balch, C.E., Research Assistant in Hydraulic Engineering, University of Wisconsin. Bulletin 700, University of Wisconsin. Paper, 6 x 9 in.; 31 pages. Madison, Wis., University of Wisconsin Engineering Experiment Station.

New York Public Service Commission for the First District. Annual report for 1913, Vol. 1. Cloth, 6 x 9 in.; 1200 pages; illustrated. New York, New York Public Service Commission, First District.

Contains a 231-page appendix by Robert H. Whitten on "Public Service Regulation in Great Britain."

Books Reviewed

Engineering Directory for 1915

Twenty-second Edition. Part 1, cloth, 4 x 7 in.; 894 pages. $5 net. Part II, cloth, 8 x 10 in.; 468 pages, $2 net. Parts I and II together, $6 net. Chicago, the Crawford Publishing Company.

Volume I contains a list, which the publishers have attempted to make as complete as possible, of the dealers in, and also the large consumers of, manufactured products. The list embraces dealers in mill, mine, heating and lighting supplies, hardware, tools and machinery; manufacturers of these lines who are also consumers of manufactured products; and manufacturers in other lines, such as the automobile, textile and fertilizer industries, who are also consumers of such manufactured products. A list giving the names and addresses of officers of the trade associations of the country closes the volume. In the lists of dealers and jobbers for the United States and Canada information is given as to the organization of each company, both in form and personnel, and as to its capital stock and financial condition. Each item ends with the name of the buyer for the firm. It would seem that lists of the larger mine owners and contractors who are direct buyers of heavy machinery and hardware in considerable quantities would not be out of place in this volume. It also seems that if the list of leading architects of the country here published is of value to the subscribers of this work, a list of the leading engineers of the country would also be worth including.

Part II of the directory is an additional volume which is published this year for the first time. It is essentially a buyers' handbook. It contains a directory of the manufacturers of machinery and supplies of all sorts classified under approximately four thousand headings. A twenty-page index enables the user to locate the manufacturer of a line of goods through the trade name of his product.

Report on the Iron Canyon Project

By the U. S. Reclamation Service, in co-operation with the Iron Canyon Project Association. Paper; 6 x 9 in.; 147 pages; illustrated. Portland, Ore., U. S. Reclamation Service.

The report is devoted to "what is probably the largest scheme of engineering development by irrigation now under consideration on the Pacific Coast." The project contemplates the irrigation of 200,000 to 300,000 acres of land on both sides of the Sacramento River just below Red Bluff, Cal., and involves at the same time the flood control of the river and the development of from 25,000 to 30,000 hp. The report, which was prepared by the U. S. Reclamation Service, in co-operation with the Iron Canyon Project Association, presents a comparative study of the dams that might be built at the proposed site, including an arched masonry structure 165 ft. high. Numerous flow charts are given, as well as the details of a study of flood control and navigation problems on the Sacramento River and the power-development possibilities at the dam site. An interesting feature of the report is a review of the "possible progress of construction and development" year by year through the 13-year period after construction is started. Unusually complete cost estimates are presented, going into detail on each of ten plans which involve total expenditures ranging from $12,000,000 to $19,000,000.

Elements of Hydraulics

Author, S. E. Slocum, B.E., Ph.D., Professor of Applied Mathematics at the University of Cincinnati. Cloth; 6 x 9 in.; 294 pages, 210 illustrations. New York and London, McGraw-Hill Book Company, $2.50 net.

This book seems to be written for the use of students only, but its limited scope and incomplete treatment of the various subjects makes its value doubtful for those specializing in hydraulic work. The various chapters deal with the subject in an interesting way and the presentation of problems taken from such works as the Keokuk hydroelectric development, the Catskill Aqueduct, and the New York State Barge Canal tends to awaken the student's interest. The most useful part of the book is the tabular section at the end.

The book is divided into four parts: Hydrostatics, hydrokinetics, hydrodynamics and hydraulic data and tables. The treatment of the first part is by far the best. In the second part the author has failed to point out the applicability of the Kutter and Bazin formulas to the flow of water in pipes, and his statement that the exponential formula $v = Cr^m s^n$ is not accurate enough to make its use practical, indicates that he is not familiar with the important work done by Hazen, Williams and Moritz and the extent of the use of their formulas. Under the heading fire-streams only the experiment of Freemen, from 1888 to 1890, have been referred to, while Fleming's experiments at the University of Illinois in 1911 have not been mentioned. The chapter dealing with modern siphons mentions the Barge Canal siphons only, while a number, better designed, have been described in technical journals. The mathematical gymnastics in the chapter dealing with backwater are interesting, but few engineers would dare try to apply the theories. This problem is easiest solved by assuming the shape and figuring the coefficient C by means of the Chezy and Kutter formulas and then cutting and trying until both formulas give the same result. Another and more convenient way is that involving the use of the exponential equation for the flow of water in rivers. The discussion on water hammer is too brief, and important details such as air chambers and surge tanks have been neglected entirely. The treatment of draft-tubes is not satisfactory, but the chapter dealing with the selection of turbines is unusually well treated.

In several places will be found inaccurate statements as to sizes and shapes of details of existing engineering structures.

Land Drainage

Author, J. L. Parsons. Cloth, 9 x 6 in.; 165 pages; 36 illustrations; 22 tables. Chicago, Myron C. Clark Publishing Company. $1.50.

This is a treatise on the design and construction of open and closed drains, written with painstaking thoroughness and with a marked effort to make it clear to the understanding of the non-technical mind. It deals with all of the problems likely to be met with on land drainage projects, from the preliminary survey to the contractor's financing operations. The author addresses himself to the "young and inexperienced" engineer, the experienced one, the contractor and the drainage district official, but it is probable that the book will appeal to the first, third and last classes more than to the second, as in his endeavor to make himself clear to the beginner he includes much matter that will seem superfluous to the experienced engineer. Many of the tables, too, seem unnecessary in a work of this kind. Space is given to surveys, design, maintenance, plans, reports and records, cost estimates, the preparation and enforcement of specifications, division of costs and assessments, and the quality and inspection of tile. All are treated with elaborate fullness.

Water Supplies—Their Purification, Filtration and Sterilization

Author, Samuel Rideal, D. Sc., and Eric K. Rideal, B. A., Ph.D. Cloth, 8½ x 6 in.; 274 pages; illustrated. New York, D. Appleton & Company. $2.50.

Reviewed by George A. Johnson

Consulting Engineer, New York City

This book, from the pen of authors well known in this country is, as stated on the title page, essentially meant to serve as a handbook for the use of local and municipal authorities. For this stated purpose it covers the ground very well indeed, although perhaps it is somewhat too technical in parts to convey the desired thought most forcibly, quickly and plainly to the readers it is specifically intended to reach.

In the twelve chapters of which the book is composed there are discussed in order the inorganic constituents of natural waters, animal and vegetable impurities, sources of water supply, distribution, storage, preliminary purification, sand filtration, mechanical filtration, water softening, and water sterilization by physical, chemical and electrical methods. Finally there is a chapter on water analysis and the interpretation of analytical results. In the appendix there are numerous tables showing examples of water analyses, composition of boiler incrustations from different waters, order of the rocks and characteristics of waters derived from them, and examples of metal-solvent waters.

To cover with completeness such an array of subjects as noted above would fill not one but many volumes. It follows, therefore, that in this book only those features which appealed to the authors as being most essential were discussed at length. The rest are covered by more or less brief notes and references to other publications. This bibliography, it may be mentioned in passing, is a good one, as is the subject index.

The chapters on water filtration are too short to satisfy the reader who is particularly interested in this line of municipal sanitation. In America in particular this branch of sanitary science has advanced prodigiously during the last ten or fifteen years; but as before stated, it was clearly impracticable for the authors to do complete justice to this particular subject in a volume of the size under discussion. Such opinions as are expressed are fair in the main, but it is to be admitted that the data on water filtration are by no means always brought up to date, which in some ways is not so surprising in view of the very rapid advancement of the art in recent years. The chapter on water sterilization, however, is handled in a painstaking and quite thorough manner.

Taken altogether the book will be a welcome addition to municipal and technical libraries, and should also prove quite useful as a textbook. The illustrations and tables are well selected and arranged.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

The Value of Public Speaking

SIR: In an interesting editorial of your issue on Feb. 13, page 190, you have in no way underrated the value of public speaking as a means of adding to the success of the engineer. However, it seems that you have made an erroneous statement when you say: "It is impossible to include instruction in speaking in the engineering curriculum." One would hardly think that this is the case. At least the constructors of the curriculum for the engineering department of the Johns Hopkins University have not thought so, for an hour a week during the whole of the second and third years are devoted to vocal training and forensics.

The study of public speaking is an important one, so important that it should be included in the curriculum of every engineering school and not left for the student to become acquainted with as best he can.

CLARENCE E. KEEFER.

Baltimore.

A National "Factor of Safety"

SIR: In reference to the article in your issue of Jan. 30, page 133, entitled "A National Safety Factor," and the editorial in connection therewith, I would like to bring out some ideas.

It seems to me that the clearest lesson to be derived from the European situation is that preparation for National defense is not a safeguard against war. Surely the Nations now engaged in the struggle were prepared to the greatest possible extent. And equally surely the condition of none of them (with the possible exception of England) would be much worse if they had not been prepared. I am speaking of the condition of the great majority of the people.

Is not "National defense" just as much of a catch phrase in the present discussion as "vast standing army" and "military establishment for purpose of offense"? Do not all of the present combatants loudly claim that they are acting entirely on the defense.

Perhaps, if it were possible to organize an army of defense which would not be equally effective as an army of offense, such an organization would be a National safety factor. But that is impossible. The present war seems to have shown beyond question that defensive fortifications are not of any great value without a mobile army of approximately the same strength as that of the attackers. And a mobile army is what is needed in offensive operations.

Another point is that it is not generally granted that this military responsibility "must eventually devolve" on the engineering profession or any other. If we, as engineers, should be trained in military devices, so should the doctors, the surgeons, the nurses, the chauffeurs, the telegraph and telephone operators and, if the rest of the population are without any special qualifications, they should be trained to act as common soldiers.

I object not so much to any particular move toward defensive preparation as to the general acceptance of the theory that war is inevitable and that we should be prepared to accept it as such.

M. R. LEWIS.

Wenatchee, Wash.

Concrete Columns—Plain, Rodded and Hooped

SIR: In the Engineering Record of Feb. 20, page 248, there occurs the following statement in the account of the meetings of the Concrete Institute. "Mr. Godfrey would eliminate the rodded column, replacing it by plain or hooped columns."

There has been a slip somewhere. A very

considerable portion of my paper was devoted to a denunciation of the portion of the Joint Committee report that allows plain concrete columns. Here is what the Joint Committee report says about plain concrete columns: "For concentric compression on a plain concrete column or pier, the length of which does not exceed 12 diameters, 22½ per cent of the compressive strength (of the concrete) may be allowed." On the floor of the convention I was accused of making false statements in saying (among other things) that the Joint Committee report allows plain concrete columns in lengths 12 times their diameter. I leave the reader to judge from the above quotation the extent of my falsifying.

It was even stated on the floor of the convention that I deliberately ignored the part of the report that calls for rods in a rodded column. A still greater part of my paper was devoted to denouncing the portion of the report that sanctions rodded columns.

What I do endorse is the hooped column, but not the hooped column without upright rods, nor that with "square" hoops, nor that with widely spaced ties. The column requires three things—the concrete, the upright rods and the close-spaced hoops or coil. It is incomplete without any of these and is a dangerous element of construction without the hooping, as proved in numberless wrecks and in the Edison fire.

EDWARD GODFREY.

Pittsburgh.

Plate-Steel Scroll Casings for Waterwheels

SIR: In your issue of Feb. 13, page 202, you published a description of the turbines for the Nolachuckey River hydroelectric plant, in which it is stated that this installation is believed to be the first in which steel-plate scroll casings of circular cross-section have been used. To this we beg to point out that we designed and built scroll casings for water turbines of circular cross-section and decreasing in diameter many years ago, and have similar installations running.

We would refer you to the installation at Seros, Spain, built for the Barcelona Traction Company, in which four 16,000-hp units of this type are installed. (See the Engineering Record, Aug. 29, 1914, and Sept. 5, 1914, pages 250 and 279 respectively.) Smaller units with such casings were designed by us for a number of other installations.

ESCHER WYSS & COMPANY,
Head Office for Canada,
By Th. Seidl, Chief Engineer.

Montreal.

What Is Wrought Iron and What Is Steel?

SIR: It has come to my attention that many engineers who specify and use wrought iron and steel and who are not familiar with the processes of manufacture confuse the two, the prevalent opinion being that any malleable iron which contains carbon is steel, and any malleable iron which does not contain carbon is wrought iron. Wrought iron, however, may contain carbon, and steel may not contain carbon, or two different samples may show an identical amount of carbon, yet one will be wrought iron and the other steel.

The definition of the United States law is "steel is iron produced by fusion by any process, and which is malleable." The American Civil Engineers Pocket Book further adds that "It should be observed that the percentage of carbon alone is not sufficient to distinguish steel from wrought iron." Therefore, since the open-hearth process is a process of fusion, the product would be steel even though the carbon were entirely eliminated.

Some manufacturers are producing a specially refined open-hearth steel product which they term "pure iron," and I believe this term tends further to confuse the two products. While such a term may be technically correct as to chemical analysis, the product should not be confused with genuine wrought iron produced by the puddling process.

The steel manufacturers who specialize in the highly refined product are accomplishing much toward getting a rust-resisting product at lower manufacturing costs than puddled wrought iron. Time tests are the only true tests, so a comparison of the relative rust-resisting properties of the two products under normal working conditions cannot be determined at this time owing to the comparatively short period the so-called "pure iron" has been on the market. However, there is no doubt of the superiority of the so-called "pure irons" over the ordinary commercial steel products for special purposes.

Yours truly,
S. A. ROBERTS,
Civil Engineer.

Salt Lake City.

To Find Maximum Overhang of Car on Curve at Platform

SIR: It frequently happens that the end of a station platform extends to a point very near the beginning of a curve on such work as subways and other railroads with elevated platforms. In this case it becomes necessary to ascertain the maximum side excess or overhang of the car at the corner of the platform. The ordinate, z, of the center line is the same as that of the edge of the car for all practical purposes.

In the figure, A and P are the truck centers, O is the point of curve and a is the distance from the platform to the point of curvature. For ease of figuring and simplicity of resulting formula the circular curve will be considered as a parabola with vertex at the origin O. The error due to this assumption is negligible as will be shown by an example.

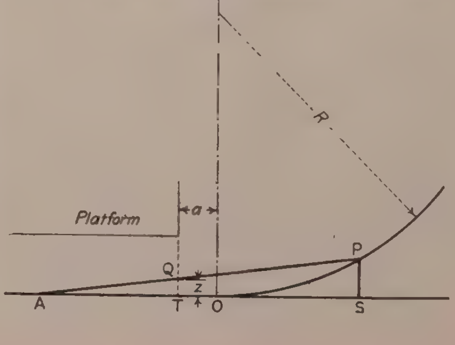
The equation of this parabola is

$$y = mx^2 \qquad (1)$$

in which the constant m must be found. The radius of any curve is given by the formula

$$R = \left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2} \div \frac{d^2y}{dx^2} \qquad (2)$$

In equation 1 $dy/dx = 2mx$, and $d^2y/dx^2 = 2m$. Substituting in equation 2 we have



$$R = [1 + (2mx)^2]^{3/2} \div 2m \qquad (3)$$

At the origin

$$R = 1/2m \text{ or } m = 1/2R \qquad (4)$$

and equation 1 becomes

$$y = x^2/2R \qquad (5)$$

as the equation of the curve. This is the parabola which has the same radius at the point of curvature as does the circular curve. And the curvature is practically unchanged throughout the portion to be considered.

In the figure call the distance between truck centers L and consider AS to be equal to L. In this figure OS is x and SP is y. by similar triangles QT : AT = SP : AS—that is, $z : L - (a + x) = y : L$. Substituting the value of y from equation 5 we get

$$z = \frac{(L - a) - x}{L}\left(\frac{x^2}{2R}\right) \qquad (6)$$

or

$$z = (1/2LR)\,[(L - a)x^2 - x^3] \qquad (7)$$

By placing the derivative of z with respect to x equal to zero we get the value of x which gives the maximum value of z.

$$dz/dx = (1/2LR)\,[2(L - a)x - 3x^2] = 0 \qquad (8)$$

$$2(L - a)x - 3x^2 = 0 \qquad (9)$$

and

$$x = 2(L - a)/3 \qquad (10)$$

The substitution of this value of x in equation 7 gives, by reducing, the desired formula for the maximum z. It is

$$z = 2(L - a)^3/27LR \qquad (11)$$

When the platform extends past the point of curve the sign of the factor a changes and there is a plus sign between L and a in the numerator.

Several approximations have been made. These, however, do not introduce any significant error, as is shown by the following example, which is more severe than are any which are likely to be encountered in practice. Let $R = 400$; L, 50, and a, 2. Then $L - a = 48$.

$$\begin{array}{ll}
\log\ (L - a),\ 48, & = 1.6812412 \\
 & 3 \\
\hline
 & 5.0437236 \\
\log\ 2 & = 0.3010300 \\
\hline
\log\ \text{numerator} & = 5.3447536 \\
\hline
\log\ 27 & = 1.4313638 \\
\log\ L,\ 50, & = 1.6989700 \\
\log\ R,\ 400, & = 2.6020600 \\
\hline
\log\ \text{denominator} & = 5.7323938 \\
\hline
\log\ z & = 9.6123598 - 10 \\
z & = 0.40960
\end{array}$$

Considering the circle in its true form and placing the forward truck 32 ft. to the right of the point of curvature, and using other data as before, we can calculate the exact value of z for this spacing of the car. The 32 ft. is the value of x from equation 10. This correct value of z is 0.40997. It will be seen that the error due to the approximate formula is in the fourth decimal place even with this extreme example. Ordinarily the error would be hard to detect.

The formula is presented for what it may be worth. It is easily handled and is sure to be satisfactory. And it is far more accurate than the clumsy and slow method of trying a paper plan of the car, cut to scale, to the plotted curve and marking off the overhang for various positions of the car, which method is subject to errors of an inch or more unless considerable time and care are used in the process.

LEONARD C. JORDAN,
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Heffley Institute.
Brooklyn.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Superintendents Can Save Money by Short Time Studies

By ALLAN C. HASKELL

Principal Assistant Engineer, Construction Service Company, New York

A SUPERINTENDENT on construction work can bring about considerable saving by making short-time studies of the different operations under his control, and correcting on the spot any faults brought out by the study. The great value of a time study made while work is in progress is that a few moments' figuring will frequently show up defects which may be remedied immediately, whereas the usual method of completing reports after the job is done makes it impossible to use this feature of the information gained unless very similar work is undertaken on the next job. This seldom happens, as the details of handling construction work vary greatly even with companies who follow only one line of work.

The following time study is given as an illustration of how such work may be done, and was made by the writer on an excavation job which was being handled with wheel-scrapers. That this study does not show any great defects does not render it less important, as, having made it, the writer knew at once beyond question that this part of the work was being well done, and could turn his attention without hesitation to some other feature.

TIME CONSUMED IN VARIOUS OPERATIONS

	Waiting at loading point Sec.	Loading Sec.	Transporting, loaded Min. & Sec.	Dumping and turning Sec.	Transporting, empty Min. & Sec.
	15	30	1 55	25	2 5
	15	30	2 30	20	2 10
	95	16	2 2	17	2 5
	30	25	2 52	28	2 0
	25	25	2 58	22	2 10
	85	25	2 25	33	2 7
	30	20	2 10	25	2 25
	15	30	2 55	25	2 20
	35	32	3 5	23	2 15
	50	20	2 50	20	2 15
Av.	40	25	2 34	24	2 11

Length of haul = 570 ft. Av. load = 10 cu. ft. = 0.37 cu. yd.

Speed, loaded = 570 ÷ 2.57 = 220 ft. per min.

Speed, empty = 570 ÷ 2.19 = 260 ft. per min.

Length of day = 10 hr.

Total time of round trip = 6 min. 14 sec. = 6.23 min.

Time in transit = 4.75 min.

Other time = 1.48 min.

COST

Crew, 7 scrapers (2 horses and driver) at $5.50	$38.50
1 snatch-team (3 horses and driver) at $7.50	7.50
1 loader at $2.25	2.25
1 dump man at $1.65	1.65
1 foreman at $5	5.00
1 water boy at $1	1.00
Total	$55.90
Cost of one scraper per day	$7.99

Cost per round trip per scraper = $7.99 x 6.23/600 = 8.3 cents.

Cost per cubic yard = $7.99 x 6.23/(600 x 0.37) = 22.4 cents per yard.

Cost of hauling 1 cu. yd. 100 ft. = 22.4 x 4.75/(623 x 570) = 3 cents.

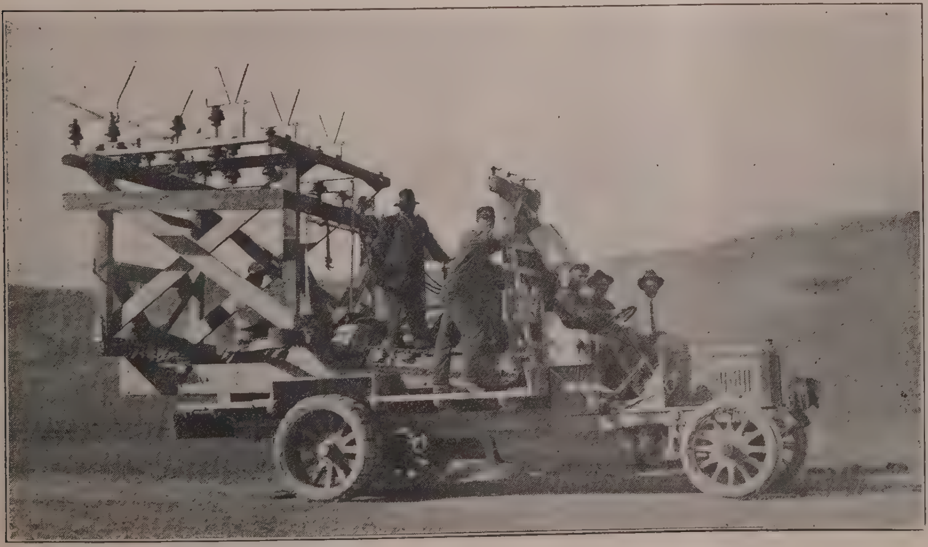
Cost for loading, dumping and waiting = 22.4 x 1.48/6.23 = 5.3 cents per cu. yd.

This, summed up, means that it cost per cubic yard, 3 cents a hundred foot to haul the material, and 5.3 cents per cubic yard to load and dump it. These figures, compared with others made on wheel-scraper work by the writer, showed that the teams were maintaining a good average speed. The analysis showed some irregularity in waiting at the loading point, however, which was eliminated by spacing the scrapers more evenly and not permitting them to reach the loading point or the dump in a bunch.

Transformer Motor Truck Aids Drilling on Sun River Project

A TRANSFORMER mounted on a motor truck, which also carried a portable Fort Wayne drilling outfit, was used with a great saving of time in making the rock cut for a 45-mi. canal of the Sun River irrigation project in Montana. The Government paralleled the canal with a 16,500-volt transmission line supplying current for the use of the excavating contractors. The work was of such a nature that drilling at several widely separated points could be taken care of by one outfit, if that outfit could be moved and set up in a sufficiently short time. The problem was solved by mounting a transformer, which took current at 16,500 volts and reduced it to 220 volts for the use of the drill, on a motor truck, which transported the whole outfit from place to place as it was wanted. This outfit, which is shown at work in the accompanying cut, was called on to drill holes 20 ft. in depth. Its operation is said to have materially reduced rock excavation costs on this contract.

TRANSFORMER AND DRILL AT WORK



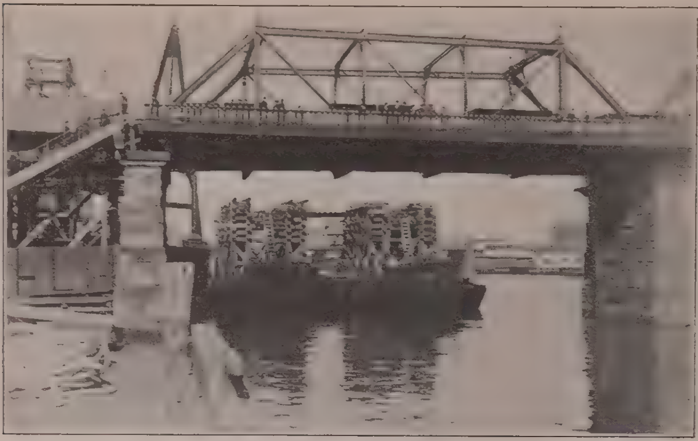
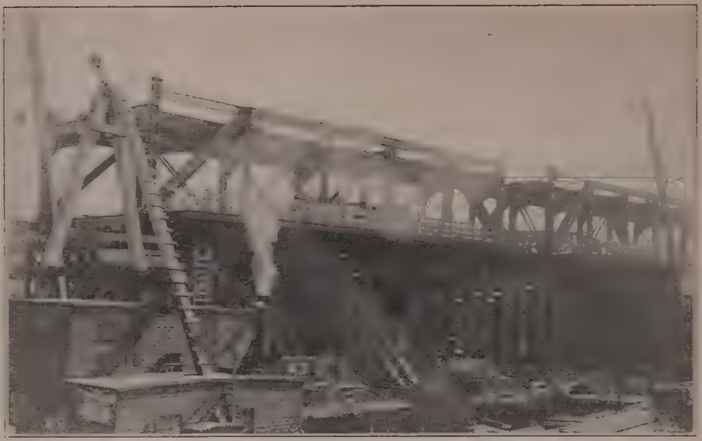
MOTOR TRUCK SAVES TIME IN CARRYING TRANSFORMER AND DRILL TO WORK

Men Carry Suspension Cables After Mules Fail

THE United States Forest Service in building a small suspension bridge over Thunder Creek in the Washington National Forest was obliged to resort to man-power to get the suspension cables to the site. The bridge, which has a 96-ft. span, was built 25 ft. above the water, and was designed to carry a very heavy snow load. All the material for the bridge had to be packed on mules for 30 mi. over a mountain trail, part of it along the edge of the Skagit River being so rough as to merit the name of Goat Trail. The two suspension cables, which were 1¾ in. in diameter and 200 ft. long, weighed 1170 lb. each. These cables had a steel center, and were rather inflexible. This made it impossible to load properly the cable on mule back, and the cables downed all five of the mules which attempted to carry them over the last 13 mi. to the bridge site. The cables had each to be carried the rest of the way by twenty men, each of whom packed about 10 ft. of it on his shoulder. Both cables were taken over the Goat Trail without accident, but it is said that money could not hire any member of the party to make such a trip again.

Tide Helps Replace Spans on Harlem River Bridge

A NEW approach span on the south end of the Second Avenue elevated bridge over the Harlem River in New York City was floated in place early on the morning of Feb. 22. Track on the old span was cut

BARGES READY TO LIFT OLD SOUTH APPROACH SPAN AND NEW SPANS ERECTED ON FALSEWORK BELOW BRIDGE

The near span in the right view replaced the old span in the left. Two barges floated into bays in the falsework under the new span may be seen in position to lift it.

at 2.07 a. m., and the first train, northbound, crossed the new span at 6.56 a. m.

The new north and the new south approach spans had been erected, complete even to the track, on falsework on the Manhattan bank a little below the bridge. Two bays in the falsework under each span were left for the lifting barges. These barges were floated beneath the south approach span, and at low tide on Sunday afternoon were blocked up close against the span. The bearing of the new span was on twelve sand jacks, having a drop of 3½ ft. The span floated clear as the tide rose, and was towed upstream by tugs and lashed side by side with the old span, the barges under the old span being end to end with those under the new. This left a space of about 30 ft. between the old and new spans.

It was not desirable to lift the old span by tide action alone, as traffic had to be maintained over it until 2 a. m., which was practically high tide. Accordingly the lift was made with six 60-ton hydraulic jacks. As soon as the old span was raised clear of the piers, the tugs pulled the barges upstream until the old span cleared the piers and the new span was not yet over them. Meanwhile, a jinnywink, which had been erected on an unused track over the south abutment, was slid to the middle of the bridge and placed the roller bearings for the new bridge shoes. These bearings had been previously brought to the foot of the abutment. This work took about 15 minutes. The other end of the span was fixed, and the bridge shoes rested directly on the masonry.

The two spans were than moved farther upstream, and the new span tied with hand lines in approximate position. The great drop provided in the sand jacks would have been needed if the tide had failed to reach the height expected. This sometimes happens in spite of Government predictions. It did not occur on this night, however, and the span had to be dropped 3 ft., which took it within a few inches of bearing. Meanwhile wire lines and steamboat ratchets had been run out and tightened. The span was pulled to exact location with these ratchets and lowered to bearing. The barges were floated clear of it at 7.40 a. m.

The old span, which was double-track and weighed 175 tons, was floated to the contractor's dock below the bridge and dismantled on the barges. The new span is double-deck, carries four tracks and weighs 375 tons. It is 103 ft. long. The north approach span was changed in substantially the same way on the morning of March 7. The new draw span, which has yet to be erected, will be placed in the course of the spring.

The work is being done by the Terry & Tench Company, Inc., under the direction of W. F. Cline, superintendent. It is being supervised by the engineering staff of the Interborough Rapid Transit Company, for which Bernard O'Rourke, assistant engineer, is in direct charge under F. W. Gardner, principal assistant engineer, and F. Johannesson, general assistant engineer.

Grouting Boxes for Rubble Road Shoulders

Rubble shoulders 6 ft. wide, made with rough-broken granite and grouted with a 1:3 mortar, were laid last autumn on a concrete road built just north of Atlanta by Fulton County, Georgia. The grout was mixed in the boxes shown in one of the illustrations. The special feature in their construction is a pair of rockers on one side so that the boxes can be tipped and the grout thus more quickly applied. It is then shoveled and broomed into place.

Under ordinary conditions gutters of this type would prove very expensive, but the convict labor here employed is figured to cost 40 cents per day per man, that being the cost to feed, house and care for the men. Moreover, since the convicts are available and must be cared for whether working or not, the economy of the construction is secondary.

The squares shown in one of the illustrations were laid out by the more skillful workmen, of whom there were only a few, and filled in by the rest of the crew. This kept the whole force at work on the block laying, and at the same time gave as even a surface as if the whole force had been skilled.

NEW JERSEY IN 1891 was the pioneer State in providing State aid for public highways, according to the Good Roads Year Book for 1915 to be issued this month by the American Highway Association. Massachusetts and Connecticut adopted the policy shortly after, but only during the past 10 yr. has the State-aid policy been in effect on a considerable scale. About 5000 miles of State highways were completed in 1913 and about 6000 miles in 1914, so that the past 2 yr. have been responsible for more than a third of the entire State highway mileage. The State highways in America now exceed by 6000 miles the National road system of France.

PAVING BLOCKED OUT BY EXPERIENCED MEN FOR OTHERS TO FILL—THESE BOXES ROCK LIKE CRADLES TO DUMP MORTAR

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

New York Amends Alien Labor Law

United States Supreme Court Enjoins Interference with Alien Labor Pending Final Decision on Constitutionality of Statute

A bill, which passed both houses of the New York State Legislature and went to the Governor on March 10, permits the employment of alien labor on State work, and provides for revalidating all contracts voided under the old law. The bill was bitterly opposed by labor leaders. It states that when citizen labor is "not available" alien labor may be employed. It is understood that the word "available" means not only presence at the job and willingness to accept the scale of wages, but also physical and mental fitness for the work required. It is said that if the bill is interpreted in this way the New York city subway contractors will have no difficulty in completing their work. Construction meanwhile has gone forward after a fashion on practically all the New York subway contracts, and conditions are now expected to return rapidly to normal.

The section providing for the revalidation of existing contracts requires that the surety companies on the bonds of contractors for State work shall be parties to the revalidation and that application for the modification of existing contracts shall be made within thirty days after the bill becomes law. The bonding companies were made parties to the revalidation merely to make sure that their bonds would remain in force after modification of the contracts.

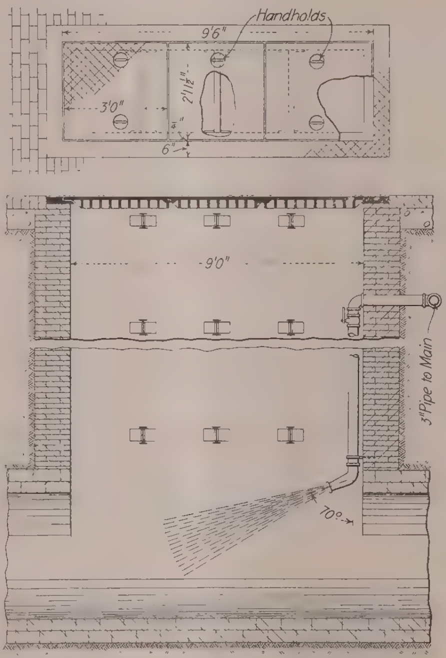
Action of Supreme Court

Meanwhile, on March 4, the Supreme Court of the United States had granted an injunction restraining the Public Service Commission of New York from interfering with the employment of aliens on subway contracts pending a decision in the suits carried to the Supreme Court to test the constitutionality of the old law. There was some doubt among the contractors about the effect of this injunction, and on March 8 Chief Justice White, in a statement in open court, made it plain that even if the contractors employed foreign labor pending the decision of the supreme court they would have to be paid for the work done up to that time. The taxpayers attacking the old law moved for an advancement of the hearing in the case, and it is expected that a date in April will be set.

Washington Ready to Spend Millions on Highways

The State Legislature of Washington has granted appropriations for an unusually extensive road-building compaign, involving the expenditure of millions. The following telegram from the State highway commissioner embodies the news of this important work:

"The State Legislature has just appropriated $2,152,288 and reappropriated $153,640 for the construction and maintenance of State highways and $4,000,000 for construction and maintenance of other permanent highways. These amounts will be expended during the biennium beginning April 1. In addition there will be expended about $4,000,000 from county funds for roads and bridges. The above does not include any expenditures that may be made within the limits of incorporated cities and towns."



SEWER SNOW DUMP AT ST. LOUIS—THE WATER JET BREAKS UP A DUMPED LOAD, PREVENTS BRIDGING, AND AUGMENTS FLOW IN SEWER

St. Louis Is Using Improved Snow Dumps

Director C. M. Talbert Tells of Latest Developments in Use of Sewer Manholes with Water Jets for Disposal of Snow

The latest form of sewer snow dumps, used by the city of St. Louis, is shown in the accompanying drawing. It represents 6 yr. experience in varying the size of the openings, methods of adjusting the cover plates, size of the water supply pipe and, most important of all, changes in the location and direction of the water jet. C. M. Talbert, director of the Department of Streets and Sewers, has supplied this journal with the following information regarding this method for snow removal:

The water pressure should be at least 25 to 30 lb. and the sewers used for this purpose should not be less than 2½ x 3½ ft. In the larger sewers in St. Louis there has been at all times a sufficient flow of water to carry away snow without the aid of the water jet. The purpose of the jets in the smaller sewers is two-fold—to break up a load of dumped snow and prevent it from bridging over the small sewer and to augment the flow of water and give it sufficient volume to carry the snow into the main sewer.

The point in size of sewer on which one might be able to dispense with the water jet depends largely upon the flow of water in the sewer and can be determined only by a trial. In St. Louis about 8 ft. is the smallest in which it was possible to dispense with the jet.

St. Louis has thirteen of these dumps located in the central section of the city, and expects to increase this number by building at least two each year until it will be possible to take care of the entire downtown district without causing teams to wait in line to unload. The sewer dumps also do away with long hauls to the riverfront, where a large quantity of snow is now piled and which is later washed away by the rising river.

Senate to Investigate Arch Patents

The resolution submitted by Senator Bristow authorizing the committee on patents to investigate the issuing of patents to Daniel B. Luten passed the United States Senate on March 1. The committee is given full power to summon witnesses and administer oaths for securing evidence and is directed to report the result at as early a date as practicable.

THE ST. LOUIS SNOW DUMPS REPRESENT 6 YEARS OF EXPERIENCE IN VARYING SIZE OPENINGS, ADJUSTING COVER PLATES, AND FIXING ON THE SIZE AND DIRECTION OF THE WATER JET

Western Pacific Railroad's Receivers Appointed

Frank G. Drum, president of the Pacific Gas & Electric Company, and Warren Olney, Jr., attorney, were appointed receivers for the Western Pacific Railroad, March 3, by Judge Van Fleet of the Federal District Court sitting in San Francisco, Cal. In its petition for a receivership filed with the court, the Equitable Trust Company of New York, which holds the deed of trust to the entire holdings of the road, asked that Mr. Olney, who has been the road's chief counsel for several years, be named as receiver. Judge Van Fleet, in making the appointments said that he had added the name of Drum as a receiver for two reasons: First, because conditions of the foreclosure warranted the ability of a financier as well as legal talent to adjust its affairs, and second, because there might be some objection to the appointment, alone, of the counsel for the road. The receivers were each placed under bonds of $100,000.

Holders of Western Pacific interest coupons due March 1 were refused payment when they presented their claims. It is stated these claims will not be presented to the Denver & Rio Grande, which guaranteed their payment, and that suit may be brought by the coupon holders to force payment.

John F. O'Rourke Expresses Appreciation of Alien Labor

At a recent hearing on the suggested repeal of the New York alien labor law, in Albany, N. Y., John F. O'Rourke, the contractor, spoke feelingly of his workmen and of the aliens. He said in part:

"I haven't heard an American sentiment expressed by the other side. There isn't a real bonafide American in the room; we are all aliens. Some of us came by way of Plymouth Rock, some by other ports of entry. But we are all aliens. And there isn't a man here to speak for the many union men we have been compelled to let out as a result of the Court of Appeals decision, although they are paying their good money to keep these advocates of simon-pure, non-alien, labor alive.

"I feel very kindly toward recent importations of the transatlantic steamship companies," he continued after a brief interruption, "and I frankly recognize the fact that God Almighty created some of those fellows a great deal better than he created me. And, if you want to know about our relations with the men, why let any one try to do personal violence to me, and I guarantee there won't be enough left of him to pick up between a thumb and one finger if any of my men happen to be around."

Engineer Suggests State Highway Work for Unemployed

A comprehensive plan by which the unemployment situation in Oregon may be solved by means of State highway work was outlined by H. L. Bowlby, State highway engineer of Oregon, in his recent annual report. Mr. Bowlbys' plan favors the establishment of two road camps situated comparatively close together, in a part of the State where the climate is not too severe in Winter. One of these camps to be outfitted similar to a contractor's camp, and the men paid a nominal wage and furnished good board and bunks. The other camp to be a stockade camp, with more or less work for the men to do, and board given in the proportion of work done. With these camps established, according to Mr. Bowlby, all unemployed could then be given their choice of working in the first camp and receiving a moderate wage and good food for their work, or of spending the winter at the second camp, where they can be kept at the least expense to the public and not become a nuisance by congregating in large numbers in the cities. Such an arrangement, rigidly enforced, it is claimed, would relieve those who actually are in want, and expose those who pretend they want to work but never get further than the pretension. The scheme, it is estimated, would require an appropriation of $100,000 to take care of 1000 unemployed men for a period of sixty days.

The value of the road work resulting from such an expenditure would not, in Mr. Bowlby's opinion, exceed 50 per cent of the results to be obtained by contract work, but it is suggested that the cities would be relieved of a great problem that is difficult to solve within the limits of a modern city.

Western Advanced-Rate Case Opened in Chicago

The hearing on the question of higher rate for forty-one Western railroads was begun March 4 in Chicago before W. M. Daniels of the Interstate Commerce Commission. The application affects more than 98,000 mi. of road, and, if granted, is expected to bring about increased revenues amounting to $10,000,000 per year.

New Power Transmission Link Authorized in New York

By approving franchises for the St. Lawrence Transmission Company to extend its lines from Norfolk, N. Y., to Hannawa Falls, there connecting with the Northern Power Company, and from Massena north to the Canadian border, and a connection with the Cedars Rapids Transmission Company of Canada, the New York Public Service Commission, Second District, has made possible a new link in the chain of power transmission lines in northern New York. The franchises do not allow the company to compete with various local companies operating in the villages en route.

New Record of Weekly Traffic Through Panama Canal

A new record of traffic through the Panama Canal for a period of a week, under normal conditions, was established during the week ended Feb. 21, states the "Canal Record." Thirty-three vessels passed through, thirteen from the Atlantic to the Pacific, and twenty in the opposite direction. Thirty-six vessels made the trip during the week ended Oct. 27, 1914, but many of these were boats that had been held back the preceding week on account of a slide. The previous record under normal conditions was twenty-eight vessels.

Wants United States to Buy Western Pacific Railway

Both houses of the California Legislature introduced a resolution March 9 urging the United States to buy and operate the Western Pacific Railway, which recently passed into a receivership. The resolution declares that unless the Government buys the road it will become allied with other transcontinental systems and competition will be destroyed. The belief is also held that operation of the road by the Government would afford a test of the feasibility of Government ownership of railroad lines.

South Carolina Architects Endorse Licensing Plan

At the annual meeting of the South Carolina Association of Architects, held at Columbia, S. C., recently, a bill defining the qualifications of an architect, and requiring an examination and license to practise in the State, was unanimously endorsed. A committee was appointed, composed of two of its members, to present the bill to the Legislature.

New Company to Develop Water Power at Minetto, New York

A method of utilizing a large waterpower at Minetto, Oswego County, New York, has been approved by the State Public Service Commission, Second District. A new company, the Northern New York Power Corporation, is to be created to develop the power, the stock to be taken by the Columbia Mills, Inc., owner of the power, in part payment therefor. The new company, in turn, is to lease its output to the Niagara, Lockport & Ontario Power Company for use on its Syracuse and other nearby lines.

The new corporation is authorized to issue $900,000 of 6-per cent first-mortgage bonds, paying $350,000 in cash to the Columbia Mills for its water rights and $455,000 to complete the hydroelectric development. Capital stock to the amount of $500,000 is also to be issued and turned over to the Columbia Mills as the balance due for the property transferred.

Inasmuch as the Columbia Mills sells a small amount of electricity to employees and other neighbors the Public Service Commission rates it an electrical corporation, but allows it to hold stock in the newer corporation on the ground that the Columbia Mills owns valuable water-power properties which it is not now in a position to develop.

In approving the franchise for the delivery of the electric power to the Niagara, Lockport & Ontario system and the furnishing of the same to the present customers of the Columbia Mills, the commission compels the companies to stipulate that they will not interfere with the business of the People's Gas & Electric Company, which is serving the city of Oswego.

Concrete Roads for Lexington

As a result of an inspection of Milwaukee's concrete roadways, White Guyn, city engineer of Lexington, Ky., will recommend that, as an experiment, the city pave a few of its streets with that material this year.

Fame Indeed!

Colonel Goethals has been so highly honored for his achievement at Panama that it would seem impossible to do anything further to show the esteem of the American public. The Engineering Record submits, however, that an announcement made by Wanamaker's department store in New York this week puts the canal builder among the truly elect. "Goethals Grit" is the name of a new shade of silk which this store has originated. The announcement describes it as: "A new greenish sand color, not too dark—a distinguished shade for Easter gowns."

Lest it should lose the possible advantages from the present interest in Panama the store also announces the following "Panama shades": Cristobal red, Panama blue, Balboa green, Culebra green and Pacific gold.

Chicago Engineers Cooperate with Association of Commerce

That Chicago engineers are alive to the possibilities of cooperation with commercial organizations is evidenced by a recent communication from the division of engineers to the main council of the Chicago Association of Commerce. Plans submitted for official sanction are as follows:

"We intend to make this subdivision influential by inviting all members of the association concerned with engineering matters, directly or indirectly, to participate in our activities.

"We are prepared to furnish press articles for dissemination, through the proper officers of the association, on engineering subjects of interest in Chicago.

"We are prepared to give any desired assistance in shaping public policy, or the policy of the association, on subjects where the ordinary business man will be compelled to call for expert advice.

"We will impress upon our fellow members the fact that Chicago is the great central market for engineering skill and ability, as much as for any other commodity."

New Building Code Proposed for Massachusetts

A State-wide building code, creating four building districts, the first embracing fireproof buildings only, the second semi-fireproof buildings, the third closely built-up suburbs and the fourth sparsely settled localities, has been filed in the report of the commission appointed two years ago by Governor Foss, to investigate the building laws and fire conditions in Massachusetts. This code would be, in effect, a minimum law to be exceeded at local option, and is designed in such a way that little disturbance to existing conditions will result. The commission is satisfied that the total expense involved under the proposed code, State and local, would not be much greater than at present.

The proposed law brings up to date existing codes on classified building and construction, but leaves to local building inspection officials all responsibility for work within their jurisdiction. The provisions of the metropolitan fire hazard law, now in force, are extended to cover the entire State, making the present fire-hazard commissioner head of one of the new State building departments. The building inspection department of the Massachusetts district police will also be embraced in this scheme.

Chicago Railroads Ordered to Elevate Tracks

The Illinois Public Utilities Commission issued an order March 2 for the elevation of the tracks of the Pittsburgh, Cincinnati, Chicago & St. Louis Railway, the Englewood Connecting Railway and the Baltimore & Ohio Chicago Terminal Railway at Marquette Road, Sixty-seventh Street, Garfield Avenue and Fifty-fifth Street, Chicago. The order is in accordance with an ordinance passed by the city council April 22, 1912, which was protested by the railroads affected.

Efficiency Commission Studies Chicago Water Supply

A comprehensive and constructive report on the problems of the water supply of Chicago has been initiated by the Bureau of Public Efficiency. Alvord & Burdick have been retained to do the work and in co-operation with John Ericson, city engineer, and other city officials, is now engaged in preparing a preliminary report to see what direction further study can be followed with the most profit.

Every phase of the waterworks department as a whole, including water waste, collections, accounting, efficiency, filtration, pumping, distribution system and future policies will be touched upon.

Heavy Machinery the Feature of Chicago Cement Show

An old-timer aptly summed up the eighth annual Chicago Cement Show, which closed Feb. 17 after a seven-day session, when he said, "It has been a heavy-machinery show and they have had the best buying crowd I've ever seen." On the first day, as was to be expected, the percentage of curiosity seekers was large. This steadily decreased, however, until within three days after the show opened the majority of visitors were contractors or construction engineers who were there to see; and if they found what they wanted they left orders. The show differed from last year in that all of the concrete machinery companies exhibited. The interest in concrete for road construction and for farm structures was unusually keen. New devices were scarce, and they consisted in the main of minor improvements on several of the machines.

The Universal Portland Cement Company occupied the entire north end of the Coliseum, and aside from being exceedingly artistic and attractive its exhibit might be characterized as educational of every phase of the cement and concrete industry, from materials to the finished product. The simplicity of the use of bulk cement was emphasized by an exhibit which consisted simply of a shed filled with cement. The Lehigh Portland Cement Company had its scenic model of last year on hand.

A feature of the show that follows directly in line with an editorial in the Engineering Record of Feb. 6, page 158, was the vast amount of publicity.

Change of Contract Quantities No Ground for Suit

The Washington State Supreme Court recently handed down a decision in the case of Keiburts, Smith & Rountree against the city of Seattle which held that change of location stakes by the city did not relieve the plaintiff from loss due to a bad bid on work, the quantity of which was increased by changing the location. These contractors, who constructed a reservoir for the city on Beacon Hill, sued the city for the sum of $13,080, which they claimed was due them on the ground that the city engineers changed the stakes on the reservoir, compelling the contractors to do much more excavation work than they had planned upon. Their unit bid on excavation was an unprofitable one, the contractors claimed, and had been made only in connection with a bid for refilling the gullies of the reservoir site. By changing the stakes the city not only increased the excavation, but eliminated all refilling. The court decided that such changes were permissible under the unit plan of bidding, which is in vogue in many sections of the coast.

Exposition Attendance Exceeds Million in Two Weeks

Official statistics from the Panama-Pacific International Exposition at San Francisco show that the attendance for the first 14 days totaled 1,036,349, a daily average of 74,025, which is a new record for exposition attendances. It is stated that an average monthly attendance of 1,000,000 will pay the running expenses of the undertaking and leave a margin, but Exposition statisticians estimate that the attendance will never fall far short of 2,000,000 in any one month.

Twenty-five Million Dollars for Rivers and Harbors

In a substitute for the bill originally presented to Congress $25,000,000 was appropriated for the preservation and maintenance of existing river and harbor works, and for the prosecution of such projects, authorized hitherto, as may be most desirable in the interest of commerce and navigation and most economical and advantageous in the execution of the work. In the Senate it was only by the unprecedented step of awakening the vice-president at 4 o'clock in the morning that a quorum was obtained to pass the bill.

Panama Canal Closed by Slide and Reopened Within a Week

After being closed for nearly a week to the traffic of all vessels except those of light draft, owing to a slide in the Culebra cut, the Panama Canal was reopened for regular service March 10. Twenty-seven ships passed through—the record for a single day.

Engineers to Discuss Amendments to New York Constitution

An informal discussion will be held at the house of the American Society of Civil Engineers in New York on the evening of March 17, with reference to such amendments to the New York State constitution as would affect engineers or their tenure of important State positions. A constitutional convention will be held in April, in accordance with the New York practice of revision at 20-year periods. The importance of immediate action is, therefore, apparent. The society has appointed a committee, consisting of Arthur S. Tuttle, Alfred D. Flinn and Henry W. Hodge to study the matter. The primary purpose of the meeting is to give the committee the benefit of the views of those interested in the subject. It is expected that the committee will open the meeting with a statement of what its study of the constitution and of possible amendments has disclosed.

All engineers, no matter in what branch of the profession they are specializing, and whether they are members of national societies or not, are urged to attend.

Contractors' Bond Covering Liens of Mechanics Declared Invalid

The California law which provides for a contractors' bond covering the claims of material men and mechanics was held unconstitutional on Feb. 27 by the San Francisco superior court of that State. The law provided that if the owner failed to file a bond, or cause the contractor to file a bond, protecting liens of mechanics and material men which might arise if the contractor failed to satisfy the claims of such persons, then the owner and the structure built for him under the contract could be held for all such liens, even if they exceeded the amount of the contract price.

Inland Waterways Association of California Plans Congress

The annual meeting of the Inland Waterways Association of California will be held in the Exposition auditorium in San Francisco on March 25, 26 and 27, and is being arranged as a congress at which over a thousand delegates are expected. The proceedings are to include a discussion of inland waterway improvement from both the State and the National viewpoint. As affecting California, the subjects will include the promotion of irrigation, reclamation, flood control, power and storage reservoirs.

A committee of nineteen under the direction of Isidor Jacobs of San Francisco has been given charge of arrangements, and it is planned to arrange for the attendance of a number of National and International authorities on the subjects to be debated.

Flood Prevention Works to Be Started in Imperial Valley

Upon receipt of news that the people of Imperial Valley had raised the $100,000 upon which the expenditure of a like amount, appropriated by Congress for flood prevention purposes, was conditional, the Secretary of the Interior directed Gen. W. L. Marshall, U. S. A. (retired) to proceed to that location at once, to start the work, which consists of the construction of revetments along several miles of the Colorado River and the raising of what is known as the Volcano Lake levee.

Water-Power Bills Die in the Senate

The conservation measures governing the leasing water-power sites, the passage of which was urged by the President, died with the sixty-third Congress, which ended its session March 4. The matter is commented on in the editorial columns of this week's issue.

Track Elevation on Big Scale for Chicago in 1915

The railroads entering Chicago will elevate 98.41 mi. of track and 17.07 mi. of roadbed during 1915, according to the schedules they have recently filed with the city. The cost of the season's work is roughly estimated at $10,000,000. The railroads have filed schedules as follows: Chicago, Milwaukee & St. Paul, 4.13 mi. of roadbed and 11.16 mi. of track; Chicago, Rock Island & Pacific, 1.81 mi. of roadbed and 7.09 mi. of track; Chicago & Western Indiana, 1.5 mi. of roadbed and 8 mi. of track; Pennsylvania, 3.8 mi. of roadbed and 51.47 mi. of track; Wabash, 3.08 mi. of roadbed and 11.44 mi. of track; Illinois Central, 2.5 mi. of roadbed and 9 mi. of track; Michigan Central, 0.25 mi. of roadbed and 0.25 mi. of track.

Up to Dec. 31, 1914, the railroads have spent altogether $76,236,269 in elevating 1,079 mi. of track and 169 mi. of roadbed in the city.

Granite-Block Pavement Men Hold Conference

Several weeks ago there was held in Boston a conference between the manufacturers of granite block for paving purposes and representatives of the skilled laborers who lay them. This conference was a forerunner of a meeting of wider scope to be held in New York shortly between the manufacturers of the block, the owners of the granite quarries, the contractors who put down such pavements and those—the skilled laborers—who actually lay them. Inspectors, representing engineers and municipalities, will also be invited to participate in the conference, the object of which is to insure granite block paving of the highest quality, by raising standards for the work from the quarry to the finished street.

The Granite Block Paving Manufacturers' Association recently organized is taking the leading part in arranging for the conference.

Big Four Roundhouse at Benton Harbor Destroyed by Fire

In a fire which started at an early hour on March 4, the Cleveland, Cincinnati, Chicago & St. Louis Railroad's roundhouse at Benton Harbor, Mich., was entirely destroyed. Three locomotives in the building were badly damaged. The estimated loss is placed at $60,000.

Ohio Senate Kills Measure to Obstruct Conservancy Law

Attempts to cripple the Ohio Conservancy Law were frustrated on March 10 by the State Senate, which, by a unanimous vote, has postponed the Garver bill indefinitely, thus practically killing a measure which would have prevented the Dayton Flood Prevention Committee from carrying out its plans. The Garver bill can not be presented again in its same form. There may be an attempt to pass a companion measure in the House, but it is believed that further efforts to obstruct the Ohio Conservancy Law will not receive serious consideration at this session of the Legislature.

News of Engineering Societies

The Engineers' Club of Boston heard Earl M. Harvey lecture on "Mosquitoes" at a meeting held March 11.

The Engineers' Club of Trenton, N. J., held its regular monthly meeting March 11. Alfred Gaskill, State Forester, presented an illustrated paper on "Treeless Trenton."

The Toledo Society of Engineers will hold a meeting March 26. Professor Hoad, head of the sanitary engineering department of the University of Michigan, will be the speaker.

The Engineers' Club of New York City announces that the talk on "The Naval Service Gyroscope" by Elmer A. Sperry which was to have taken place March 12 has been postponed until March 18.

The Brooklyn Engineers' Club held a regular meeting March 11. Frank W. Skinner, consulting engineer, of New York, presented a paper on "Underpinning, Raising and Moving Structures," illustrated with lantern slides.

The Vermont Society of Engineers held its third annual meeting at Burlington March 11. James Hartness spoke on "Vermont and the Engineers," and David Williams on "The Influence of the Engineer in the Development of the Country Through Railroad Construction and Operation."

The Association of County Road Engineers of Kentucky elected the following officers at a meeting held in Louisville Feb. 25: President, Jacob Strous; first vice-president, W. H. Edwards; second vice-president, W. P. Caldwell; third vice-president, C. S. Woodward; secretary, J. Frank Grimes.

The Engineering Society of Wisconsin at its seventh annual meeting, which was held at Madison, Wis., Feb. 22 and 23, elected the following officers for the ensuing year: President, C. U. Boley, city engineer of Sheboygan; vice-president, J. F. McCullough, city engineer of Fond du Lac, and secretary and treasurer, Prof. L. S. Smith, Madison.

The Colorado Association of Members of the American Society of Civil Engineers will hold a meeting March 13. A. G. Allan will give an illustrated talk on "A Tramp Across Unexplored Country." The talk will describe a railroad reconnaissance survey, made in 1903 for the Grand Trunk Railroad, across a region of Canada, south and west of Hudson Bay. At the last meeting a resolution was adopted urging that engineers support the International Engineering Congress by becoming members thereof.

The Western Society of Engineers will hold an "Electrification Night" March 16, at which time the subject of railroad electrification will be discussed by a number of engineers prominent in that work. As the meeting will be held on the night of the opening day of the American Railway Engineering Association convention the program has been arranged so that the subject will be treated from the standpoint of the steam railroad engineer and operating officer rather than from the standpoint of the technical electrical engineer alone. W. F. Murray, consulting engineer for the New York, New Haven & Hartford Railroad, will describe the results which have been secured from the electrification of 74 mi. of railroad from New Haven to New York. Edwin B. Katte, chief engineer, electric traction, New York Central Railroad, will give an illustrated talk on electric operation on the New York Central in the vicinity of New York City. R. Beeuwkes, electrical engineer of the Chicago, Milwaukee & St. Paul Railway, Butte, Mont., will present a paper on their 440-mi. electrification project in Montana and Idaho. It is expected that George Gibbs, consulting electrical engineer of the Pennsylvania and the Norfolk & Western railroads, will also be present to discuss the problem.

Personal Notes

Ford, Bacon & Davis have been retained by the board of commissioners of the port of New Orleans to do all the preliminary work and to prepare plans for the "river to the lake canal" to be constructed by that city.

Brig.-Gens. H. F. Hodges and W. L. Sibert, whose respective promotions in recognition of their services in the construction of the Panama Canal were announced in this journal March 6, will be relieved of their present engineering duties and given details more in accordance with their new status.

Lieut.-Col. H. C. Newcomer will succeed General Hodges in charge of the water supply system of the District of Columbia and in charge of the river, harbor, and fortification works in that vicinity. Col. Newcomer is familiar with these works, having had charge of them temporarily on two previous occasions.

Gen. W. L. Marshall, U. S. A. (retired) who has been directed by the Secretary of the Interior to take charge of starting the work the Government has undertaken in connection with the Imperial Valley irrigation district, was formerly chief of engineers of the U. S. Army. Shortly after his retirement, on account of age, July 1910, he was appointed consulting engineer to the Secretary of the Interior.

H. E. Hyde, formerly principal assistant engineer on the Havana sewer system and at present connected with the engineering and contracting firm of Young & Hyde, Inc., of New York and Havana, Cuba, has returned to this country, and is at present located at Utica, N. Y. Mr. Hyde has been engaged in engineering work since 1900. He has had charge of several important works in this country, the Philippine Islands and Cuba.

B. B. Skinner, formerly assistant superintendent for the Cuban Engineering and Construction Company on the Havana sewers, has recently become connected with the firm of Jacobs & Davies, contracting engineers, on subway work in Brooklyn. Previous to his service in connection with the Havana sewer system, Mr. Skinner was assistant engineer in charge of construction of an 1,800,000-gal. reinforced concrete reservoir for the Department of Public Works of the Cuban Government.

C. A. Paquette, who has been appointed chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railway, was formerly chief engineer of maintenance of way of the same company. Mr. Paquette was born in April, 1872, was graduated from Notre Dame University in 1891, and entered the railway service immediately upon graduation. He entered the service of the company of which he is now chief engineer in 1902 as superintendent and was appointed assistant chief engineer in 1906.

Hadley Baldwin has been appointed assistant chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railway. Mr. Baldwin was born in February, 1867, was graduated from the University of Michigan in 1893, and entered the railway service that same year. He has been continuously in the employ of the company, of which he is now assistant chief engineer, from that time up to the present and had attained the grade of superintendent of the St. Louis Division previous to this new promotion.

G. P. Smith, formerly chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railways, has been appointed consulting engineer to the same road with headquarters at Cincinnati. Mr. Smith was born March 7, 1859, was graduated from the Institute of Technology, Worcester, Mass., 1885, and entered railway service June, 1886. He has been chief engineer of the St. Joseph & Grand Island Railroad, chief engineer of the Lake Erie and Western, and was appointed chief engineer of the road he is at present connected with in 1909.

B. H. Bryant, formerly chief engineer of the Mexico Northwestern Railways, has returned to this country from the Central American republics, where he has been locating railroad lines for the International Railways of America. Mr. Bryant has been engaged in railway engineering work for many years and has been chief engineer and general superintendent of many steam railroads in this country, Canada, and in the Latin-American republics. He is in Washington, D. C., at present on a vacation, but expects to resume active work in the spring.

Joseph T. Richards retired under the pension rules of the company from the office of consulting engineer of maintenance of way of the Pennsylvania Railroad, March 1. Mr. Richards entered the service of the company in

1869 as a rodman. In 1873 he became chief engineer of construction and superintendent of several minor railroads in Maryland. Two years later he was appointed assistant engineer of maintenance of way, and, from 1877 to 1883, was principal assistant engineer of the United Railroads of the New Jersey division. He became assistant chief engineer of the Pennsylvania Railroad in 1885 and attained the position from which he has retired in 1913.

Samuel Gausmann, roadmaster of surface lines, Brooklyn Rapid Transit System, has resigned to enter business in Brooklyn as a street railway track and paving expert. He will specialize in preparing estimates, arranging contracts and supervising work in this field. Mr. Gausmann began his railway career with the Middletown & Goshen Traction Company 20 yr. ago. He resigned as superintendent of that road in 1901 to go to the Brooklyn Rapid Transit System as foreman in the way and structure department. In 1911 Mr. Gausmann was appointed roadmaster of surface lines.

George A. Ricker, who, as was noted in these columns, March 6, recently resigned as first deputy commissioner of highways of the State of New York, has been appointed consulting engineer to that department. Mr. Ricker has been engaged in engineering since 1881. Much of his work has been in connection with railway lines, both steam and electrical, and, at different times, he has been chief engineer of the Niagara Falls & Lewiston Railroad, of the Buffalo Traction Company, and the Buffalo & Depew Electric Railroad Company. In 1898 he designed and estimated a $2,000,000 water power development in Niagara Gorge to utilize the power of Whirlpool Rapids. He was first deputy commissioner of highways for a period of about 2 years.

Obituary Notes

William H. Wallingford, a retired waterworks contractor, of Chicago, died in that city March 3.

Horace L. Winslow, president of the firm of Horace L. Winslow & Company, engineers and contractors, Chicago, died at his home at Winnetka, Ill., March 3.

Arthur L. Reed, civil engineer, of Whittier, Cal., died Jan. 27. In the Engineering Record of Feb. 20 his name was given erroneously as Arthur J. Reid, and the date of his death as Feb. 3.

Hiram R. Nickerson, at one time vice-president and general manager of the Atchison, Topeka & Santa Fe Railroad, and later vice-president of the Mexican Central Railroad, died recently at North Wayne, Maine.

Morton Riddle, formerly general manager of the Florida East Coast Railroad, died in St. Augustine, March 4. He was born in 1869 and entered railway service in 1891. At one time he was assistant chief engineer of the Atlantic Coast Line and, later, was general superintendent of the second division of the same road.

Civil Service Examinations

New York State.—The Civil Service Commission will hold an examination for the position of junior assistant in the engineering departments, salary $901-$1200, April 3.

Examinations Previously Announced

Date		See Eng. Record.
April 14	—Civil engineer and draftsman; copyist draftsman, Navy Department; mechanical draftsman, Panama Canal Service; ship draftsman, Navy Department; topographic draftsman, Panama Canal Service; engineer, Indian Service; United States....	Feb. 6

Steel Corporation Exhibits at Panama-Pacific Exposition

Twenty-six subsidiary companies of the United States Steel Corporation have exhibits at the Panama-Pacific Exposition at San Francisco. Maps, models and photographs illustrating various phases of their activities are the features. The Pittsburg & Conneaut Dock Company shows a model of Conneaut harbor with ore vessels entering, leaving, unloading ore and loading coal and rails for the Northwest. The coal mining companies exhibit a model of a modern coal and coke plant, showing steel head-frame and coal bin, mine buildings, tracks, miners' bathhouse, mechanically operated Beehive ovens and safety devices.

Another noteworthy exhibit is that of the American Bridge Company showing general types of office building construction.

Advantages Claimed for New Type of Road Grader

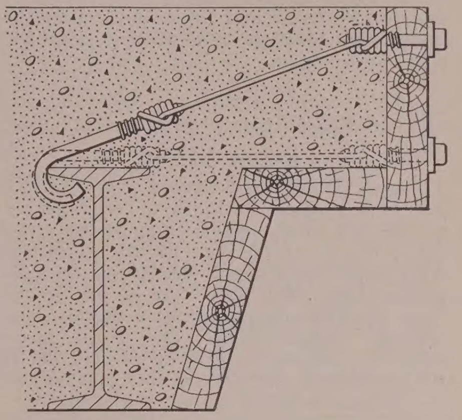
A new road machine, called the Zindorf good roads planer, grader and ditcher, claimed to be different from any machine of that nature hitherto used, has been put on the market by M. P. Zindorf, of Seattle, its inventor.

By means of a long frame, called a "landside," to which a plow is fastened in front, and a mole-board 12 ft. long, hinged to the plow mole-board, the machine is enabled to keep to a horizontal plane of travel, regardless of the unevenness of the ground underneath. The mole-board is adjustable as to the width it will cut, and also to the crown or degree of slope that is required in the roadbed. The landside is so arranged that a perfect line may be had and an even, horizontal position is maintained automatically. The operator has little to do except pull a lever back a few notches when it is desired to stop cutting, and start again by pressing a latch.

Four horses are used in trimming up established roads and six in new road construction where the work is heavy. It is claimed that the machine will handle 3000 cu. yd per day in new work, with six horses, an operator and a driver.

New Form Ties Leave Permanent Anchorage in Concrete

A new tie for concrete forms which is made up of a length of heavy wire twisted at each end to form a sleeve, and two standard ⅝-in. lag screws, has been put on the market under the trade name of "Tyscru." The ¼-in. diameter ties are kept in stock in lengths from 10 to 30 in., and the smaller ties may be had in 6 to 24-in. lengths. The sleeve on each end of these ties touches the form, so that the device acts as both a tie and a spreader. When the lag screws have been taken out and the forms removed the sockets in these ties form very convenient and substantial anchorage for finishing construction in building work. This construction is claimed to be an improvement on the familiar use of sleeve-nuts inside the forms on tie-rods for mass concrete work. The Tyscru applies the advantages of the older device to building work, and makes a further improvement in requiring a smaller number of parts for each completed tie-rod. Tyscrus are manufactured by the Unit-Wall Construction Company, Inc., of New York City.



ONE USE FOR NEW FORM TIE

Oxyacetylene Equipment Has New Features

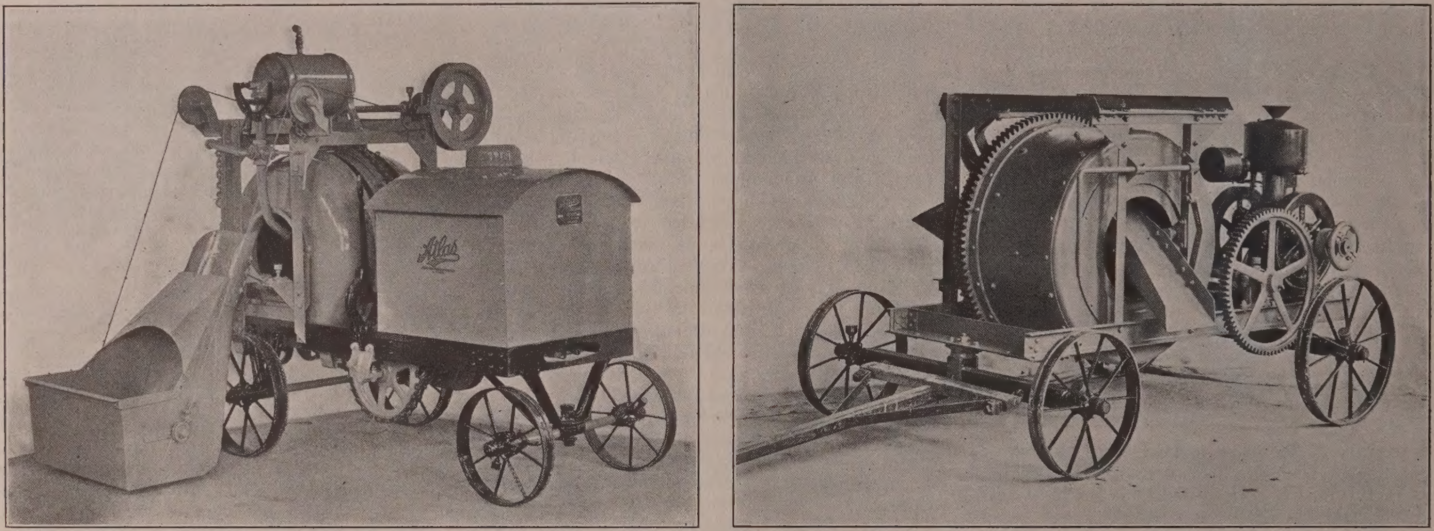
Oxyacetylene welding and cutting equipment possessing some new features has recently been placed on the market by the Imperial Brass Manufacturing Company, of Chicago. Before entering the mixing chamber of the torch the oxygen, under high velocity, passes through a spiral groove which imparts to it a whirling motion which, it is claimed, causes it to mix thoroughly with the acetylene, with the result that a uniform mixture is obtained before the gases reach the combustion point. A saving of oxygen is thus obtained and, it is asserted, an increased intensity of welding flame and greater efficiency in cutting.

The welding and cutting torches are fitted with interchangeable tips to cover all ranges within the limits of the process. The needle

ADJUSTABLE GRADER STAYS LEVEL AUTOMATICALLY IN CROWNING ROAD valves permit of fine adjustment and are located so that the operator can make the desired adjustment of the flame with the hand that holds the torch. All threading and measurements of tips are standard so that new tips for temporary use may be made from ordinary brass rods in any machine shop. The regulators, it is claimed, deliver constant, predetermined volume and velocity of gas to the torch and, in cutting operations under high pressure, will automatically shut off in an emergency.

Three-Fold Improvement on New Small Mixer

Portability, due to decreased weight through use of a pressed steel drum, encasement of engine in a sheet metal housing, and an automatic device on the side loader, which does away with complicated mechanism in disengaging the clutch are features of the new 7-cu. ft. Atlas mixer exhibited at the recent Chicago Cement Show. The Novo engine cylinder is allowed to project through the top of the sheet metal encasement, thus keeping the steam which comes from cooling water away from the mechanical parts and making it easy to fill. The automatic disengaging device consists simply of a ball placed on the cable which comes in contact with the cable guide and disengages the clutch in the manner of the ordinary freight elevator. The mixer is manufactured by the Atlas Engineering Company, Milwaukee.



LEFT MIXER HAS AUTOMATIC LOADER AND ENCLOSED ENGINE—DRUM OF RIGHT MIXER REVOLVES ON CENTRAL BEARING

Portability and Speed Features of New Car Unloader

A portable car unloader designed to meet the needs of the contractor has been placed on the market. A feature of design is the ease with which it is said the machine can be "knocked down" and taken from job to job. The boom which carries the conveying elevator can be swung to a position so that the elevator gives a clearance to trains moving along the track. It is claimed that this rigging and three men can unload 50 tons per hour. The equipment also includes a 2-ton steel bin and a 4-hp engine. The unloader, which is made in two styles, one stationary, and the other built on wheels, is manufactured by the Link Belt Company, of Chicago.

New Slide Rule for Computing Reinforced-Concrete Beams

The latest Winslow concrete computing slide rule is much extended in usefulness compared with the Winslow rule of similar hard fiber construction already on the market. Not only reinforced-concrete slabs, but also beams or girders of any type of end constraint can be quickly and easily investigated or designed for bending by this new rule. The spacing and number of reinforcing bars required can also be determined.

The rule does not, of course, apply to investigation for shear, diagonal tension or bond strength, nor does it include T-beams. It does solve beams reinforced for both tension and compression, and includes scales for determining gage and style of American Steel & Wire Company's triangular mesh and expanded-metal steel reinforcement.

Benjamin E. Winslow, engineer and architect, designed the rule, which is manufactured exclusively by Henry W. Tomlinson, Steinway Hall, Chicago. The price is $3. The instrument is 4 x 10 in. by 3/16 in. thick, of hard fiber, waterproofed, and weighs about 4 ounces.

New Drum on Low-Charging Mixer

The drum of the new low-charging 5-ft. Koehring mixer is suspended about a central bearing by a bracket attached to the steel work, which eliminates two runways, bottom rollers, shafts and bearings and, as a result, reduces the cost of production. The machine is equipped with a low-charging chute or batch hopper, Ideal engine and all-gear drive. The trucks are standard gage and the wheels 22 in. in front and 26 in. in back. Heavy steel is used on the discharge chute and mixing blades. The mixer is manufactured by the Koehring Machine Company, Milwaukee.

Business Notes

The Universal Portland Cement Company, Chicago, announces the appointment of C. S. Fletcher as manager of the sack bureau and of O. N. Lindahl as chief accountant.

W. H. Day, sales manager of the International Gas Engine Company, a subsidiary of Power, Mining & Machinery Company, has assumed supervisory control of the business of the International concrete mixer. Mr. Day is well known in engine building circles, having been head of the International Gas Engine Company for many years.

The Troy Wagon Works Company, of Troy, Ohio, is building a new plant to manufacture motor truck trailers to accommodate the growing demand for this product. The new building will cover 16,800 sq. ft. of ground and will have a capacity of more than sixty trailers a week. Three sizes are manufactured, the 1½-ton, the 2½-ton and the 5-ton.

Edward M. Hager, former president of the Universal Portland Cement Company, who is effecting the organization of a new company which will acquire a chain of Portland cement plants covering a large part of the country, has added to his staff the following men, all formerly connected with the Universal company: Gordon Wilson, formerly assistant secretary; M. Metcalf, formerly assistant to the president; C. W. Boynton, formerly inspecting engineer; L. Wesson, formerly assistant to the president, in charge of operation and construction; C. W. Lyon, formerly research engineer, and J. H. Barbazette, former superintendent of construction.

Trade Publications

The following companies have recently issued trade publications:

Harrison Safety Boiler Works, Philadelphia. Booklet, 6 x 9 in., 20 pages, illustrated. The Sorge-Cochrane hot process system of softening boiler water.

Zelnicker Crayon Works, St. Louis. Folder illustrated. Lists the various types of crayon for marking lumber, steel, railroad ties, stone, etc.; a contractor's need.

Dayton Pipe Coupling Company, Dayton, Ohio. Catalog, 5¼ x 7 in., illustrated. Covers technically the Dayton complete line of gas, water, steam and ammonia pipe joints.

C. O. Bartlett & Snow Co., Cleveland, Ohio. Bulletin 43, 8 pages, 6 x 9 in., illustrated. Outlines Cobasco system for handling materials to bins and elevations by means of ship hoists.

Blaw Steel Construction Co., Pittsburgh, Pa. Bulletin 65, 16 pages, 6 x 9 in., illustrated. An explanation of Blawforms and how they are used for concrete sidewalk, curb, gutter and road construction.

Builders' Iron Foundry, Providence, R. I. Bulletin, 6 x 9¼ in., 9 pages. Reprint of paper, "The Venturi Meter for Sewage Measurement," by Charles G. Richardson, presented before the Boston Society of Civil Engineers.

Lidgerwood Manufacturing Company, 96 Liberty Street, New York City. Bulletin 32, 9¼ x 12 in., 8 pages, illustrated. Portrays the construction plant on the filtration work at Cleveland depicting the successful use of Lidgerwood cableways.

The Austin-Western Road Machinery Co., 910 Michigan Boulevard, Chicago, Ill. Catalog, 10 x 6¾ in., 66 pages, illustrated. Road building machinery and equipment of the Western Wheeled Scraper Company and Austin Manufacturing Company types, consisting of graders, crushers, portable telescopé bins, portable crusher plants, screens, gyratory crushers, rollers, scarifiers, dump carts and cars, sweepers, sprinklers, oil distributers, drags, bucket scrapers and ditch plows, are described in detail. The catalog is a road builder's guide.